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THE CARBON AND NITROGEN METABOLISM OF STEREUM GAUSAPATUM FRIES[1]

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The importance of *Stereum gausapatum* Fries as a heartrot organism has been well established (3, 10). As previously mentioned (5) this led the writer to carry on studies of the general biology of the organism. The present paper, as the title indicates, is a study of its ability to obtain carbon and nitrogen from various chemical sources.

The cultures used were established from specimens collected at various points in the Eastern United States. The collection data, together with a study of the cultural behavior and characteristics of some of the isolates, has been reported in an earlier paper (5).

CARBON METABOLISM

Bergenthal (1) and others (2, 8) have cultured this fungus on various media but no one has reported any investigation as to its ability to use various compounds as a source of carbon. In order to investigate the ability of this fungus to use various carbon compounds, it was grown on several synthetic media, each offering a different source of carbon.

The media were prepared by mixing, aseptically, a sterile base solution with an appropriate quantity of a sterile solution of the carbon

[1]This paper is a revision of a portion of a thesis submitted to the faculty of The Ohio State University as partial fulfillment of the requirements for the degree of Doctor of Philosophy plus some additional experimental work which was performed at Kent State University.

The writer is indebted to Dr. W. G. Stover, Department of Botany, Ohio State University, for suggestions and criticisms and to Dr. H. A. Cunningham, Chairman, Department of Biology, Kent State University, for his cooperation in providing research facilities.

compound to be investigated. The base solution was of the following composition:

900.0 cc. H_2O.
0.5 g. $MgSO_4$.
0.5 g. KH_2PO_4.
5.0 g. peptone.
1.0 drop of 10% aqueous solution $FeCl_2$.
Sufficient HCl to adjust acidity to pH 5.0.[2]

Forty-five cc. portions of the base solution were autoclaved for 20 minutes at 15 lbs. pressure. Five cc. portions of a 10% aqueous solution of the various carbon compounds were placed in 250 cc. Erlenmeyer flasks and autoclaved for 20 minutes at 15 lbs. pressure. When cool, 45 cc. of the sterile base solution was added, aseptically, to each of the flasks containing the carbon compounds. Each flask thus prepared contained 50 cc. of a 1% solution of the carbon compound in question. Five days were allowed for contaminations to manifest themselves, and then five flasks of each solution were uniformly inoculated with small pieces of mycelium cut from the margin of a vigorously growing malt agar culture of a monosporous mycelium.[3] A similar set of cultures was prepared using an isolate which was started from sporophore tissue.[4] The cultures were incubated at room temperature, in darkness, for 35 days (March 17 to April 21, 1939). The amount of growth was determined by filtering the five cultures of each set through a previously weighed filter paper, rinsing twice with distilled water, and drying at 100° C. Finally, the filter papers with the fungous mats were weighed and the dry weight of the mycelium calculated. The appearance of the cultures was such as to indicate a fair degree of uniformity of growth among the 5 cultures of each isolate growing on each medium.

The essential data of this experiment are presented in Table I.

The only source of carbon in the check was the peptone and a small amount of medium introduced with the inoculum. A comparison of the dry weights of the mycelia of the checks with that produced on the other media leaves no doubt that *S. gausapatum* is able to obtain carbon from all of the compounds tested. Glycerine is obviously of slight value but it did support sufficient growth to be readily observed before filtration and the dry weight is decidedly greater than that obtained on the check medium.

On account of the insoluble nature of cellulose, the above technique could not be employed. Cultures were prepared, however, using the same base solution plus filter paper, cotton cloth, and absorbent cotton, respectively. In every case there was a luxuriant mycelial growth which clearly demonstrated the ability of the organism to obtain sufficient carbon from nearly pure cellulose.

Pure lignin was not available for this study but the writer has observed decay produced by this fungus on several deciduous woods in culture and in every case it produced a typical white rot. In nature, the writer and others (3) have observed that this fungus produces a typical

[2]The optimum pH for growth lies slightly below this. (6).

[3]This isolate, designated as *isolate* S-12, is described in an earlier paper (5).

[4]This isolate, designated as *isolate* 1, is described in an earlier paper (5).

white rot of deciduous wood. White rots are generally believed to be due to the digestion of the lignin by the fungus (7).

Tannins are aromatic compounds which are abundant in oak wood and more so in oak bark. That tannins may serve as food for *S. gausapatum* was demonstrated by the following experiments.

TABLE I

GROWTH, DURING A 35-DAY PERIOD, OF *Stereum gausapatum* ON SYNTHETIC MEDIA OFFERING DIFFERENT SOURCES OF CARBON, EXPRESSED IN TERMS OF DRY WEIGHT OF THE MYCELIUM

CARBON SOURCE	TOTAL DRY WEIGHT OF THE MYCELIUM IN MG. PRODUCED IN FIVE FLASK CULTURES	
	Isolate S-12	Isolate 1
MONOSACCHARIDES:		
Pentoses—		
arabinose	144	155
rhamnose	177	147
xylose	477	438
Hexoses—		
dextrose	354	357
galactose	429	319
levulose	602	371
mannose	454	373
DISACCHARIDES:		
maltose	646	571
sucrose	671	565
TRISACCHARIDES:		
raffinose	439	451
POLYSACCHARIDES:		
glycogen	337	399
inulin	242	251
soluble starch	618	570
NON-CARBOHYDRATES:		
glycerine	89	87
Check: 45 cc. of base solution plus 5 cc. of distilled water	18	42

Tannins are easily extracted by means of hot water (4). To 400 gms. of finely chopped bark of *Quercus velutina* there was added 1500 cc. of tap water. This was heated to 50–80° C. for four hours, allowed to stand for two days, reheated, and then twice filtered. By evaporating 100 cc. of this solution to dryness 3.55 gms. of residue was obtained. A similar procedure was followed using heartwood of the same tree. This extract was found to yield 0.65 gms. of residue per 100 cc. of solution.

A third solution was prepared by adding 1% of tannic acid to a synthetic medium which was carbon free, except for 0.5% of peptone.

Two hundred and fifty cc. Erlemeyer flasks containing 50 cc. portions of the above solutions were sterilized in the autoclave and inoculated from agar cultures of *S. gausaptum*. The cultures were allowed to develop at room temperature. After two months three cultures of each were filtered through a previously weighed filter paper, dried, and weighed to determine the dry weight of the fungous mat. The results were as follows: hot water bark extract, 441 mg. per flask; hot water extract of heartwood, 88 mg. per flask. This technique could not be employed with the tannic acid cultures because of an abundant precipitate which was formed by the reaction of the tannic acid with the peptone. Growth in this culture medium was quite slow, possibly due to the slight availability of the peptone. Upon standing for four months there was considerable mycelium in the flasks. This evidence, in addition to the fact that the fungus grows well on sterile bark or heartwood of *Q. velutina*, strongly indicates that the tannins of oak may be utilized by the fungus. The effect of autoclaving the tannins has not been investigated.

NITROGEN METABOLISM

The ability of fungi to synthesize amino acids from inorganic nitrogen compounds has been under investigation for many years (9). Bergenthal (1) reports that several species of *Stereum*, including *S. gausapatum*, grow equally well on liquid media containing peptone or $(NH_4)_2SO_4$ as the only source of nitrogen. He concludes that the protein is not essential and that the fungus can utilize $(NH_4)_2SO_4$ as a source of nitrogen.

During the present study several attempts were made to culture *S. gausapatum* on media containing nitrogen only as inorganic salts. In every case growth was similar to that occurring on nitrogen-free media. Such experiences led to an attempt to duplicate Bergenthal's results.

Twenty-one 250 cc. Erlenmeyer flasks, each containing 50 cc. of Hagen's medium and a similar set of flasks containing the modified Brown's solution were prepared. The solutions were made up according to the formulae as given by Bergenthal (1). The two liquid media were of the following composition:

1. Hagen's solution.
   - 1000.00 cc. H_2O.
   - 5.0 g. glucose.
   - 0.5 g. $MgSO_4$.
   - 0.5 g. KH_2PO_4.
   - 0.5 g. $(NH_4)_2SO_4$.
   - 10.0 drops of 1% $FeCl_2$ solution.

2. Brown's solution (modified).
   - 1000.0 cc. H_2O.
   - 2.0 g. glucose.
   - 2.0 g. peptone.
   - 1.25 g. KH_2PO_4.
   - 0.75 g. $MgSO_4$.

The flasks of media were autoclaved for 20 minutes at 15 lbs. pressure. Twenty-four hours later the pH value of Hagen's solution was found to be 5.0, of Brown's solution, 5.2. In Bergenthal's media the acidities were reported as pH 6.3 and pH 6.1 respectively. The lower pH value reported here is possibly due to a more severe sterilizing process, but Bergenthal does not state how he sterilized his media. Each of the 21 flasks of Hagen's medium was inoculated with a different

isolate of *S. gausapatum*. The cultures used were isolates 1 to 21 inclusive, as described in an earlier paper (5). The 21 flasks of Brown's solution were inoculated in the same manner with the same 21 isolates. The cultures were then incubated in semi-darkness, at room temperature.

A casual periodic observation of the cultures revealed a much better growth on the Brown's medium than on the Hagen's medium. The difference was constant for all of the 21 isolates used. After three months the 21 cultures grown in each medium were all filtered through one filter paper, dried, and the weight of the fungus determined. The total dry weight of the 21 mycelia grown on Brown's medium was 565 mg., while the total dry weight of the 21 mycelia grown on Hagen's medium was only 90 mg. As will be seen later, mycelia grown on media containing no source of nitrogen may show a greater dry weight than was shown by the mycelia growing on Hagen's medium. It is obvious that the isolates of *S. gausapatum* which the author has studied are not able to obtain nitrogen from $(NH_4)_2SO_4$ as effectively as they can from peptone. It does not seem possible that Bergenthal had a strain which differed so greatly in its physiology.

The results presented above together with the fact that no previous work has been reported led to further study of the the ability of *S. gausapatum* to obtain nitrogen from various sources. The fungus was grown on synthetic media using various compounds as the only source of nitrogen. A base solution was made up as follows:

1000.0 cc. H_2O.
5.0 g. KH_2PO_4.
2.5 g. $MgSO_4$.
0.2 g. $FeCl_2$.
50.0 g. sucrose.

To one lot of this solution 1% of peptone was added. To other lots appropriate quantities of other nitrogen compounds (Table II) were added. The amount used in each case was such that the solution would contain the same percentage of atomic nitrogen as the 1% peptone solution. The actual quantities added are shown in Table II.

For each compound to be tested five 250 cc. Erlenmeyer flasks, each containing 50 cc. of solution were prepared and sterilized at 15 lbs. pressure for 20 minutes and then uniformly inoculated with a monosporous isolate. After a 30 day incubation period, at room temperature, in semi-darkness, the five flask cultures on each medium were filtered through a previously weighed filter paper and the dry weight of the mycelium determined. The average dry weight of the mycelia grown on the various media are shown in Table II.

The accompanying data indicate that peptone is the only compound tested from which *S. gausapatum* can readily obtain nitrogen. The mycelia growing on media containing asparagine, NH_4NO_3 and NH_4Cl show a slightly greater growth than the check. The difference, however, is not great, and the number of cultures employed is small. It does not, therefore, seem wise to attach any significance to the difference. The slight gain in dry weights of the check and of some others is probably due to (a) the weight of the agar and fungus introduced, (b) the slight growth allowed by the peptone present in the introduced bit of culture and (c) to precipitate formed in the solution. That the first

and third of these factors are of importance is indicated by the dry weight of the mycelia, etc., of the $NaNO_2$ cultures. $NaNO_2$ is so toxic, in the concentration used, that absolutely no growth took place, yet the dry weight of the mycelia, etc., compared favorably with that obtained on certain other media.

In order to investigate the toxicity of the nitrogen compounds a duplicate set of cultures was prepared, in which the media were the same as above except that 1% of peptone was present in addition to the other nitrogenous compound. The fungus appeared to be killed promptly by the solution containing $NaNO_2$, but a luxuriant growth occurred in the presence of all of the other compounds. It is obvious that $NaNO_2$ is very toxic, whereas, the other nitrogenous compounds are not toxic in the concentration used.

TABLE II

GROWTH OF *Stereum gausapatum* IN 30 DAYS ON SYNTHETIC MEDIA OFFERING VARIOUS COMPOUNDS AS SOURCES OF NITROGEN EXPRESSED IN TERMS OF DRY WEIGHT OF THE MYCELIA

Source of Nitrogen	Amount, in gms., of N-compound Added to 1 Liter of Base Solution	Average Dry Weight, in mgs., of Mycelium per Flask
Peptone	10.00	541
Asparagine	7.25	60
NH_4NO_3	4.50	55
NH_4Cl	6.75	59
$(NH_4)_2SO_4$	7.75	35
KNO_3	11.50	22
$NaNO_3$	9.75	36
$NaNO_2$	8.00	28
Check	0.00	35

SUMMARY AND CONCLUSIONS

The ability of *Stereum gausapatum* Fries, important cause of heartrot of oak, to use carbon and nitrogen from various sources has been investigated.

The fungus was found to grow well in culture with the following compounds as the only source of carbon: xylose, dextrose, galactose, levulose, mannose, maltose, sucrose, raffinose, glycogen, inulin and soluble starch. Rhamnose and arabinose were much less effective and glycerine was found to be of very little value but did support some growth. That lignin and tannins may serve as food for the fungus is indicated by various experiments and observations.

Synthetic media containing peptone supported a heavy growth of mycelium but when the nitrogen was furnished only

in the form of inorganic salts (NH_4NO_3, NH_4Cl, $(NH_4)_2SO_4$, KNO_3, $NaNO_3$, $NaNO_2$) or asparagine growth was not significantly greater than on a nitrogen-free medium. The fungus is therefore not able to use appreciable amounts of nitrogen from such inorganic compounds. $NaNO_2$ is definitely quite toxic. The other compounds were shown to be non-toxic.

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Fleas of Eastern United States

The last taxonomic revision of the order Siphonaptera appeared in 1904. Since then various authors have contributed many short and scattered articles on the subject, but it remained for the author of this book to bring together all this information into one volume.

The scope of the work is confined to a consideration of the species occurring east of the one-hundredth meridian with the exclusion of Texas. In this area are known to occur five families, comprising thirty-three genera and fifty-five species. Present knowledge indicates that they are parasitic on about seventy-five mammalian and avian hosts including man and domestic animals. Keys to suborders and genera are included. There are thirty-one plates of drawings illustrating morphological characters used in species separation.

Preceding the taxonomic presentation is a chapter on collecting, preserving, morphology, terminology, life history and control of fleas. Besides the usual index at the end of the book there is also a synonymic index and a host index. A selected bibliography is appended.

The book has been used by students in the medical entomology class for determining some unidentified specimens and has been found to be very satisfactory. The descriptions are very complete and the illustrations excellent. This book is a worthwhile and valuable addition to the library of every entomologist and should be a handy reference for the medical man and veterinarian as well.

—*R. H. Davidson.*

Fleas of Eastern United States, by Irving Fox. vii+191 pp. Ames, Iowa, The Iowa State College Press. 1940. $3.00.

NEW AND RARE SPIDERS FROM THE GREAT SMOKY MOUNTAIN NATIONAL PARK REGION

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Family AGELENIDAE

Coras cavernorum, new species

(Figure 1)

Female.—Total length 13 mm. Cephalothorax 6 mm. Abdomen 7 mm. Cephalothorax widest part between second and third leg, 4 mm. Cephalothorax at eye region, 2.6 mm. Width of posterior lateral eyes, 1.6 mm. Length of first leg, 20 mm.

Cephalothorax with the usual markings. A dark line from posterior lateral eyes to an elongated hexagonal light area which has its posterior point on the outside of a dark hexagonal area which ends lateral to the dorsal groove. A faint line from posterior middle eyes to the elongated light hexagonal area. The anterior angle of this area bisected by a dark line which is an extension of the line from the posterior lateral eyes.

Anterior part of head a rich yellowish brown. This color becomes lighter toward the posterior edge of the cephalothorax where it is lemon color.

The legs are the same color as the head except the distal end of femur and the patella which are lemon. Faint bars show on the upper side of femora and tibiae. The femora underneath show three well marked dark bars; the first or basal is narrow; the second or middle bar and the subapical are broad.

Abdomen a dark greenish gray. The indefinite pattern is made up by the underlying white which shows through. A basal dark stripe extends half the length of the abdomen. It is broken in the middle by a white spot between two muscle impressions. On the posterior part are five chevrons. The two anterior are broad and irregular flocculent white spots. The three posterior are inverted V marks, each made up of a single row of small white dots. Just above each posterior spinnerette a long white horizontal dash mark.

Venter of abdomen with a long dark shield-shaped center broken by two small white spots just below the epigynum. The dark center is surrounded by large irregularly placed white spots. Sides of venter dark with small white dots.

Epigynum wide, but narrow from front to back.

Sternum dark with a central light line which nearly meets a posterior light diamond mark.

One female from a small cave six miles west of Waynesville, N. C., at 3500 ft. September 30, 1936. A. Stupka Coll.

Family LEPTONETIDAE

Leptoneta gertschi, new species

(Figure 2)

Male.—Length 1.4 mm.

The ground color is yellowish white overlaid by a granular brownish purple. The darkest parts are the sternum, edges of thorax, venter and sides of the abdomen. The dorsum of the abdomen shows a faint light herring-bone pattern.

The palp on the outside shows a characteristic set of spines (Fig. 2). A terminal projection of the cymbium bears in a pit a flattened spine of peculiar shape. Behind this with its origin near the base of the projection is a long delicate hair. A small papilla proximal to the constriction of the tarsus bears four delicate spines one of which is broadened and flattened, spatula-like at the end. These spines are followed by two large forward curving spines in front of which there is a delicate straight spine. The anterior edge of the tibia bears five spines in a group. The upper which is heavy and flattened at the base is longer than the tarsus and patella together. The others from a half to a third the length of the upper.

The inside of the palp shows below the constriction in the tarsus a small brownish chitinized patch shaped like the wing-cover of a beetle. Below this patch there is on the front edge of the bulb a fan-shaped group of six or seven straight hairs directed forward.

Two males. Greenbrier section of Great Smoky Mountain National Park, Tenn. June 14, 1939. (Sifting leaves.)

Leptoneta coma, new species

(Figure 3)

Male.—Length 1.52 mm.

The color and general conformation is like the species silvicultrix and gertschi but the males can be easily distinguished by the palp and its peculiar specialized hairs and spines.

The tarsus of the palp is deeply cleft at the distal end forming an upper and lower lobe. Seen from the outside the lower lobe is nearly as large as the upper but bears on its lower side a secondary lobe or knob (Fig. 3) which bears a small black flattened spine set in a pit. The upper lobe has the usual long hairs of which four stand out as being heavier than the others. The middle lobe bears on its upper edge a long delicate hair below which are several short hairs, the lower one plumose. Proximal to the constriction in the tarsus is the usual series of spines one of which is flattened slightly. The most distinctive feature of the palp is a series of eight extremely long hairs which arise along a vertical line on the middle of the inside of the bulb and extend forward side by side beyond the middle lobe of the tarsus. These are white at the tips. The tips of four are shown in the figure. The specific name refers to this wisp of long hairs.

Two males. Seven females. Gatlinburg, Tenn. June 21, 1936. Sifting leaves near the river.

Family THERIDIDAE

Theridium sex-setosum, new species

(Figure 4)

Male.—Length 1.4 mm.

Thorax black except for two pale tan streaks which extend from below the anterior lateral eyes around the sides to the posterior declivity where they end abruptly. The lower edge of the thorax back of the first legs milk white. Sternum brownish tan.

Abdomen black with markings as follows: on the dorsum two pairs of round white spots each surrounded by a pale parchment-like area; above the spinnerettes several white spots which form a rough triangle pointed downward. Lower sides of abdomen with a long white spot. Venter brownish black with a pair of small white spots in the middle.

Legs pale transparent with black hairs.

Palps pale to the end of the tibia which is black. Tarsus of palp tan.

Between the two rows of eyes are six black erect robust spines evenly spaced. These are about as long as the clypeus is wide. The anterior tibia bears at the center of its inner face a robust tapering spine which is almost half as long as the segment itself.

Palpal organ outside view as shown in Fig. 4.

One male. Headquarters Area of Great Smoky Mountain National Park, Tenn. June 12, 1939.

Theridium ambitum, new species

(Figures 5 and 5A)

Male.—Length 1.25 mm.

The pedicle is inserted on the abdomen behind the middle in such a way that the abdomen is vertical in position.

The forelegs are very long (3 mm.), the fourth pair short (1.5 mm.).

The cephalothorax short and almost as broad at third legs as it is long. The anterior edge is broadly rounded, the clypeus vertical retreating almost as high as the chelicerae are long. In profile the cephalothorax rounds up from the posterior margin and becomes horizontal at its highest point at the posterior eye row.

The colors are: Legs pale white contrasting strongly with black spines and hairs. Cephalothorax yellowish white faintly lined with greenish gray. Abdomen white clouded more heavily toward the spinnerettes with grayish green, but showing some small white spots. Spinnerettes white.

The distal end of the first tibia on its inner face bears a short spur from the top of which arises a heavy black slightly curved spine. From the base of the metatarsus there arises a small spine which is directed slightly downward in such a way that when this joint is flexed the smaller spine makes contact with the upper edge of the larger spine. (Fig. 5A.)

The palpal organ is broad and flat except at the distal end where the cymbium is elongated and bent downward at an angle of 85°. This extension of the cymbium is coiled into a trough which carries the black tips of the embolus and conductor. (Fig. 5).

One male. Laurel Falls Trail, Great Smoky Mountain National Park, Tenn. June 15, 1939. (Sifting in pine needles.)

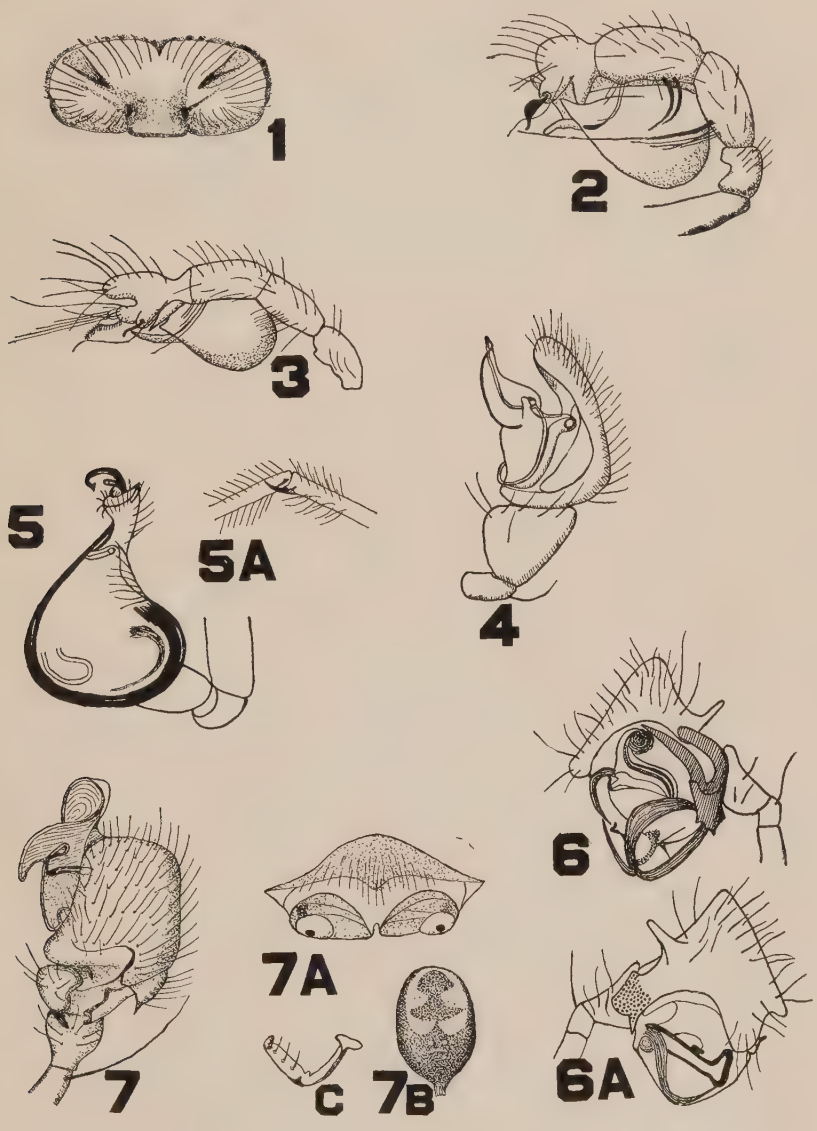

Fig. 1. Coras cavernorum, epigynum.
Fig. 2. Leptoneta gertschi, outside view of left palp.
Fig. 3. Leptoneta coma, outside view of left palp.
Fig. 4. Theridium setosum, outside view of left palp.
Fig. 5. Theridium ambitum, ventral view of left palp. 5A. Inside view of right tibio-metatarsal joint.
Fig. 6. Bathyphantes officiosus, outside view of left palp. 6A. Inside view of same.
Fig. 7. Lepthyphantes ornithes, left male palp. 7A. Epigynum. 7B. Female abdomen showing pattern from the dorsal view. 7C. Paracymbium.

Family Linyphiidae

Bathyphantes officiosus, new species

(Figures 6 and 6A)

Male.—Length 1.75 mm.

Thorax yellowish clouded with black which forms a dark margin.

Legs light yellow. Bases and undersides, particularly the coxae white.

Sternum yellow clouded with black, particularly the posterior edge.

Abdomen greenish black with a white middle cross band which slopes backward on each side but does not reach the venter. Venter black.

Chelicerae swollen at base, much constricted distally, the fang groove broad, flat, excavated laterally, without teeth.

The palpal organs are shown in Figs. 6 and 6A.

Two males. Headquarters area, Great Smoky Mountain National Park, Tenn. June 14, 1939.

Lepthyphantes ornithes, new species

(Figures 7, 7A, 7B and 7C)

Male—Length 2.5 mm. First tibia 2.5 mm. First metatarsus 2.4 mm. First tarsus 1.1 mm.

Cephalothorax pale orange yellow somewhat clouded by gray along the edges.

Legs pale orange yellow.

Abdomen pale yellow with an overlaid pattern of gray somewhat obscure but showing the peculiar "bundle of wheat" mark easily seen on the two darker females. (Fig. 7B.)

Sternum and venter of the abdomen darker than dorsum. Sternum longer than wide (15 : 14) straight across the front or slightly reentrant, widest between coxae I and II slanting directly to the rather broad extension between the hind coxae.

The palpal organ (Fig. 7) is atypical in three respects: the embolus is long and follows the edge of a broad membranous fold; the base of the cymbium is excavated, the excavated portion partially covered by an innerfold and an outerfold and grooved tooth; the usual apophyses are either absent or very much reduced.

The paracymbium is fairly typical for this genus. (Fig. 7C.)

Female.—The two females at hand are much darker than the male, the legs being dusky and the abdomen almost black and white (Fig. 7B). The epigynum (Fig. 7A) appears as if made up of two gasteropod shells with the large openings toward the abdomen. When seen from behind the two parts appear as two bird heads placed beak to beak.

Male and female. Sugar Grove, Ohio, Oct. 26, 1918. Under a log in a wooded ravine.

Female. Little River, Great Smoky Mountain National Park, Tenn. Sept. 3, 1936.

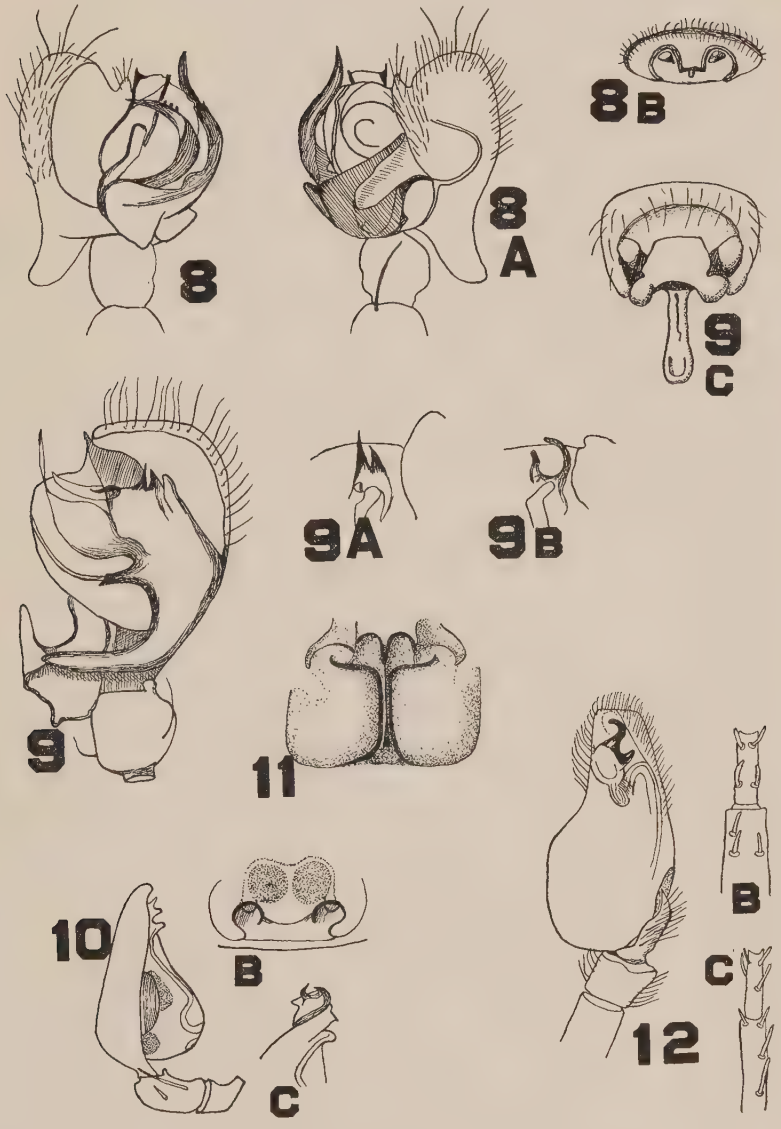

Fig. 8. Microneta olivena. 8 and 8A. Two views of right palpal organ. 8B. Epigynum.
Fig. 9. Microneta tennapex, palp. 9A. Black teeth on end of palp to be compared with 9B similar teeth in Microneta latidens Em. 9C. Epigynum.
Fig. 10. Castianeira stupkai, inside view of left palp. 10B. Epigynum. 10C. Dorso-mesial view of embolus and conductor.
Fig. 11. Liocranoides unicolor, epigynum.
Fig. 12. Pseudicius lecontei, left palp. 12B. Left foreleg, ventral view showing spines on tibia and metatarsus. 12C. Left second leg, ventral view, showing spines on tibia and metatarsus.

Microneta olivena, new species

(Figures 8, 8A and 8B)

Male.—Length 1.5 mm.

Cephalothorax above and below pale buff clouded with sooty black without a definite pattern except a darker edge.

Legs pale buff.

Abdomen above and below dark gray.

Eyes on black spots.

Sternum squarely truncated across the front and widest between the first and second coxae. It is moderately bowed ventrally.

The palp (Figs. 8 and 8A) is much like that of Emerton's Microneta olivacea.

Female.—Length 2 mm.

Color and general configuration like the male. Through the kindness of Miss E. B. Bryant I have been able to examine male and female specimens of Microneta olivacea from Mr. Emerton's collections taken on Mt. Mansfield, Vt. June 17, 1909. The epigynum of olivacea is short and thick while in olivena it is long and more narrowly oval in cross section as indicated in Fig. 8B.

One male and one female. Camp No. 1 near Gatlinburg, Tenn., Great Smoky Mountain National Park, Tenn. Mar., 1937.

Microneta tennapex, new species

(Figures 9, 9A, 9B and 9C)

Male.—Length 2 mm.

The general color is a pale dull yellow clouded with sooty black.

Cephalothorax edged with black with the usual radiating lines and median line.

Eyes on jet black spots. The spots surrounding the posterior median eyes extend posteriorly into fine sharp points.

Sternum and venter are dusky but smooth and shiny.

Coxae and trochanters pale yellow as are the patellae, metatarsi and tarsi. Femora clouded distally as are the tibiae.

Chelicerae have on the outer lateral surface a double or triple row of very short stiff closely packed spines which extend from the cheliceral base almost to the base of the fang. This group of spines looks like a black cheliceral line.

Female.—Same size and marked exactly like the male except that the abdomen shows a few small white spots widely separated. These appear to be in four longitudinal rows.

This species seems to be quite like Emerton's *Microneta latidens.* Through the kindness of Miss E. B. Bryant I have been able to compare these specimens with some specimens of *Microneta latidens* which were taken at Newton, Mass., on Nov. 22, 1904. Fig. 9B shows the two peculiar palpal spines of *M. latidens.*

Figs. 9, 9A and 9C show the palpal organ and epigynum.

Several males and females, Summit of Clingman's Dome, Great Smoky Mountain National Park, Tenn. Mar. 19, 1937.

Family Clubionidae

Castianeira stupkai, new species

(Figures 10, 10B and 10C)

Male.—Length 8 mm. Cephalothorax 2.6 mm. Abdomen 2.4 mm. General color golden orange suffused with reddish brown.

Cephalothorax elliptical, widest at the second coxa, high evenly rounded from side to side, rising from the posterior border to a point just back of the head then falling slightly to the eyes. The clypeus is vertical or slightly retreating as wide as the eye area. Anterior eye row slightly procurved the medians separated by one third the diameter of one, the lateral eyes almost touching the medians. Seen from above the anterior eye row is recurved; the second eye row wider then the first, slightly procurved, the medians separated by a diameter, close to the laterals. Each eye is narrowly surrounded by black. Dorsum of the cephalothorax faintly marked with minute reddish spots growing more intense in color toward the borders. The chelicerae are about as long as the head is high above them. They are uniformly swollen somewhat retreating; the furrow of the chelicerae with two teeth above and two below. The distal tooth of each group is large, an equilateral triangle, the more proximal smaller.

Sternum yellow longer then wide with a few dark hairs directed inward.

First leg dark up to the middle of the femur, yellow to the base of the metatarsus. The metatarsus is dark, the tarsus white. Fourth leg darkened except for the extreme distal end of the tibia and the tarsus which are white.

Abdomen narrow anteriorly gradually widening to the three quarter mark where it is widest. From this point it is evenly rounded across the end. The dorsum is darkened with red dots and covered with golden hairs except for two rings of white hairs, the first at the distance of one fifth from the anterior end, the second at the two fifths mark. There is some evidence of a pair of white spots behind the second ring. The white rings run down the sides but do not cross the venter. The anterior seven eighths of the dorsum of the abdomen is covered by a shiny thin scutum which is detected with difficulty. This is flat, rectangular, and smooth. Just in front of the spinnerettes is a large tuft of thickly set erect black hairs longer than the spinnerettes and occupying about the same space.

The palps are darkened. The palpal organ as illustrated (Figs. 10 and 10C).

Female slightly larger than the male due to the increased size of the abdomen, colored and marked like the male except that the front metatarsus is not darkened. The white tip of the posterior tibia is missing; and the abdomen shows two basal white marks. The scutum on the abdomen is basal, nearly square, half as wide as the abdomen.

The epigynum (Fig. 10B) shows the usual two openings.

Male. Gatlinburg, Tenn. June 25, 1936. (In Andropogon field.)

Female. Gatlinburg, Tenn. May 21, 1937. Glen Sheets Coll.

Liocranoides unicolor, Keys

(Figure 11)

Female.—Length 9 mm.

Except for the epigynum which is shown in Fig. 11 Keyserling's description is adequate for this species.

Female. Great Smoky Mountain National Park, Tenn. Sept. 17, 1937. (Under rock on hillside above C. C. C. Camp.)

Family Attidae

Pseudicius lecontei, new species

(Figures 12, 12B and 12C)

Male.—Length 3.5 mm.

General color blackish lead partially covered with large irridescent scales showing white, pink or green colors.

Thorax low flattened sloping upward from the anterior eyes in a rounded curve to the point where the posterior declivity descends sharply. Thorax widest just in front of the posterior declivity.

Eye area darker than the remainder of the cephalothorax. The quadrangle of the eyes wider behind. The third eyes very small, nearer the second row. The anterior row seen from above recurved, the laterals about one-fourth the diameter of the medians. Thorax has a marginal band of white hairs and a wider sparse supra-marginal band which starts at the anterior median eyes and passes around to the edge of the posterior declivity.

Abdomen elongated overlapping the thorax in front, widest at the middle, narrowing to a point at the spinnerettes. Dorsum covered with irridescent scales but showing a short white basal band.

Bases of the legs, sternum and venter are lead black with a few irridescent scales.

The palps are dull black above and below but are tipped with white. The first leg is somewhat enlarged; the femur, tibia and tarsus dark, the patella is lighter, and the metatarsus white. The three remaining legs have the femur dark. The patellae and tibiae are dark above and below but have heavy stripes of large white scales running along the anterior and posterior edges. The metatarsi are white with a distal black ring. The tarsi are white. In the sunlight the lines of scales on the patellae and tibiae (Ohio specimen) glow with a bright cerise pink color giving the impression that the spider is surrounded by a pink picket fence.

The anterior margin of the cheliceral groove bears one small black tooth distant from the fang base. The posterior margin bears a similar large triangular tooth. The spines on tibia I (Fig. 12B) are (1, 0), 2, metatarsus 2, 2; tibia I (Fig. 12C) 2, 1, 1, metatarsus 2, 1 plus 1 anterior lateral.

The fang shows a basal half thickened, opaque, and a distal narrowed region clear enough to show the poison duct. Palpal organ as figured (Fig. 12).

One male. Top of Mt. Leconte, Great Smoky Mountain National Park, Tenn. Aug., 1937.

One male. Higby, Ohio. (From a dry wash) June 19, 1931.

NOTES ON SOME OHIO APHIDS[1]

CLYDE F. SMITH
Assistant Entomologist

While collecting aphids and parasites in Ohio during the years 1936–1939 the writer has found two species of apparently undescribed aphids. He has also collected several species which have hitherto been unrecorded for Ohio. It is deemed advisable to publish the records and the descriptions of the new species in order to have names to use in recording the parasites, and to add to the list of Ohio Aphidae.

The following list was prepared as a supplement to the lists published by Guyton (Ohio Jour. Sci. 24: 1–30, 1924) and Cutright (Ohio Jour. Sci. 25: 313–314, 1925). Unless stated otherwise the following material was collected in Ohio by the writer.

Essigella pini Wilson. Hocking County, June 26, 1938, on *Pinus virginiana.*

Cinara tujafiliana (Del Guercio), Columbus, August 14, 1937, on Arborvitae (N. F. Howard; R. H. Davidson).

Unilachnus parvus (Wilson). Monroe County, July 23, 1938, on *Pinus* sp. and Hocking County, June 26, 1938, on *Pinus* sp.

Saltusaphis scirpus Theobald. Logan County, June 23, 1938, on *Scirpus* sp.

Plocamaphis flocculosa (Weed). Columbus, June 19, 1938, on *Salix* sp.

Aphis acritus n. sp.[2]

Alate vivipara.—Color dark greyish-black, only slightly pulverulent; antennae, metathoracic legs, cornicles and cauda dark, pro- and mesothoracic legs paler; (cleared specimens) head and thorax dark, abdomen with dusky areas about the base of the cornicles, between the cornicles and cauda, along the sides of the body and with a few smaller dark areas down the middle of the back. Body 1.77[3] (1.57–1.96); hairs on

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[1]Contribution from the Department of Zoology and Entomology, North Carolina State College, published with the approval of the Director of the North Carolina Experiment Station as Paper No. 113 of the Journal Series.

[2]The writer wishes to express his appreciation to Dr. G. F. Knowlton and Prof. E. O. Essig for their opinions concerning this species.

[3]All measurements are given in millimeters, measurements in parenthesis indicate paratype variations. Variations in measurements of structures figured are given on the figures and not repeated in the text.

vertex, abdomen and tibiae .02; antennae 1.57 (1.44–1.6); antennal III, .40 and bearing 40 sensoria; IV, .26 and bearing 11 sensoria; V, .22 and bearing 1 secondary sensorium; VI, .14 plus .36; rostrum attaining first abdominal segment; rostral IV plus V, .12; hind tibiae .94 (.93–.96); hind tarsi .15; cornicles .17; cauda .09 for the hard portion and .15 total length.

Collections.—Holotype and 3 paratypes (alate vivipara) collected at Columbus, Ohio, June 17, 1938, on *Sedum* sp. Collections of alate vivipara were also made on the same plant June 10, 1938, (2 specimens) and October 7, 1938 (1 specimen).

Apterous vivipara.—Color greyish pulverulent, nymphs yellowish; legs and antennae slightly lighter than in the alate vivipara; cornicles and cauda dark; (cleared specimens) head slightly dusky; thorax pale; abdomen with a large dark patch between the cornicles and cauda and a few very small patches on the dorsum and sides. Body 1.72–1.85; hairs on vertex .034; antennae 1.41–1.64; rostrum attaining first abdominal segment; rostral IV plus V, .12–.13; hind tibiae .86–.94; hind tarsi .15; cauda .11–.12 for hard portion, .17–.18 total length.

Described from 6 paratypes collected with the holotype, and 5 paratypes in the June 10 collection.

Apterous ovipara.—Color as in apterous vivipara. Antennae 1.27–1.30; antennal III, .28; IV, .22; V, .2–.23; VI, .12–.13 plus .31–.33; rostrum attaining first abdominal segment; rostral IV plus V, .11; hind tibiae .73–.80; hind tarsi .14; cornicles .17–.19; cauda .11 for the hard portion, .14–.16 total length.

Collection.—On *Sedum* sp. at Columbus, Ohio, Oct. 7, 1938 (21 specimens). This collection was made on the same plant the holotype was collected from.

Alate or Apterous males.—Color very similar to alate vivipara. Body 1.09–1.58; antennae .97–1.58; rostral IV plus V, .08–.10; hind tibiae .56–.86; hind tarsi .09–.12.

Collection.—6 alate and 1 apterous specimens collected with the apterous ovipara.

Taxonomy.—*Aphis acritus* differs from *A. rumicis* in having more sensoria on the antennae of the alate vivipara. The alate vivipara of *A. rumicis* may have a relatively large number of sensoria (20–23) in the fall forms, however, the writer knows of no case where the spring forms have this many. In *A. acritus* the number of sensoria seem to be fairly constant in the spring and fall forms of the alate vivipara. *A. acritus* also differs in the senoria being more tuberculate in alate vivipara; in bearing fewer hairs on the cauda; and in the shape of the hind tibiae of the apterous ovipara and the number and arrangement of the sensoria.

Aphis dibilicornis (Gillette and Palmer). Columbus, September 22, 1937, on *Helianthus tuberosus.*

Aphis frangulae Kaltenbach. Columbus, October 8, 1936, *Nepeta cataria.*

Aphis medicaginis Koch. Columbus, June 19, 1938, on sweet clover.

Aphis neogillettei Palmer. Columbus, May 1, 1938, on *Cornus* sp.

Aphis nyctalis Hottes and Frison. Hocking County, May 1, 1937, on *Senecio* sp.

Aphis oestlundi Gillette. Columbus, May and June, 1938, and Monroe County, July 23, 1938, on *Oenothera.*

Aphis saliceti Kaltenbach. Columbus, June and July, 1938, on *Salix* sp. Also in Pickaway County, July 7, 1938 (J. S. Caldwell).

Amphorophora ribiella (Davis) Columbus, June 18, 1938, on *Ribes* sp.

Capitophorus braggii (Gillette). Delaware County, October 9, 1938, and Columbus, October 2 and 14, 1938, on thistle.

Capitophorus gillettei Theobald. Columbus, October 14, 1938, on *Polygonum* sp.

Capitophorus ohioensis n. sp.[4]

Apterous vivipara.—Color greenish appearing overcast with greyish-white because of numerous fan-shaped or capitate hairs, antennal I, II and basal ⅔ of III concolorous with head, remainder of antennae dark brown to black; legs pale, shading to brownish on the tibiae and tarsi; cornicles light brownish; cauda pale. Length of body 2.19 (2.11–2.35); hairs on vertex (.02–.04); hairs on antennal III, 0.1; antennae 2.86 (2.67–3.14); antennal III, .61 and bearing 2 or 3 sensoria; IV, .50; V, 43; VI, .15 plus 1.02; rostrum attaining second pair of coxae; rostral IV plus V, .11 (.10–.12); hind tibiae 1.30 (1.30–1.38); hind tarsi .15; cornicles .42 (.42–.51); cauda .23 (.23–.28) for the hard portion and .31 (.28–.34) for the entire length.

Described from the holotype and 3 paratypes taken on the underside of leaves of *Helianthus* sp. at Columbus, Ohio, October 15, 1938.

Apterous ovipara.—Color same as apterous vivipara described above; body (2.04–2.50); hairs on vertex (.03–.04); hairs on antennal III, .01; antennae (2.37–2.74); rostral IV plus V, (.11–.12); hind tibiae bearing 65 to 75 sensoria; hind tarsi .15; cauda (.17–.22) for the hard portion and (.23–.26) total length.

Described from 37 paratypes taken with the holotype.

Alate male.—Appendages somewhat darker than the apterous vivipara; body 1.41 (1.41–1.57); hairs on vertex .03; antennae 2.50; antennal III, .51 (.51–.53) and bearing 35–41 (27–43) sensoria; IV, .50 (.50–.52) and bearing 28–30 (22–30) sensoria; V, .39 (.39–43) and bearing 18–21 sensoria; VI, .12 (.12–.14) plus .81 (.78–.81); rostral IV plus V, .09 (.09–.11); hind tibiae 1.19 (1.18–1.22); hind tarsi .15; cornicles .15; cauda (.07–.12) for the hard portion and (.12–.18) total length.

Described from allotype and 2 paratypes taken with the holotype.

Holotype, allotype and a few paratypes to be deposited in the U. S. National Museum, paratypes in the collection of the writer.

Taxonomy.—*C. ohioensis* resembles *C. wasatchii* Knowlton from which it differs in cornicles being longer than antennal V in the apterous vivipara and in the body hairs being longer and having a more distinct shaft. The body hairs on *C. wasatchii* are much denser and more conspicuous than in *C. ohioensis.*

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[4]The writer wishes to express his appreciation to Dr. G. F. Knowlton for his opinions concerning this species.

Macrosiphum ambrosiae (Thomas). This species is common throughout the state and was collected on *Helianthus* sp., *Solidago* sp. and *Sonchus* sp.

Macrosiphum coryli Davis, Hocking County, June 26, 1938, on *Corylus* sp.

Macrosiphum illini Hottes and Frison. Columbus, August, September and October, 1938, on *Helianthus* sp.

Macrosiphum niwanista (Hottes). Columbus, July 9, 1938, on *Solidago* (?).

Hamamelistes spinosus Shimer. Columbus, May 12, 1938, and May 20, 1939, on *Betula* sp. This aphid was seriously damaging a young birch tree that was being used for ornamental purposes.

Littoral Fauna

Civilized man lives in an environment which differs from that experienced by all other animals. He plunges almost from birth into a world of objects with labels. His first nursery school text shows a cat, a dog or other object underneath each of which is its printed name. Eventually he learns that language is a system of vocal labels or written labels which can be juggled into sentences, paragraphs and even into written book notices. He soon realizes that life can become very embarrassing if he forgets and mixes labels, and refers to a girl friend as a lemon. He lives in a world of labels. He soon thinks labels.

Curiously enough he tends to avoid objects whose names or labels are unknown to him. Unnamed objects confuse his thinking, or actually make certain types of thought (word juggling) difficult or even impossible.

Hence the pleasure one derives from such a volume as the one before us. Miss Eales, Lecturer in the Zoology Department of the University of Reading, has given us just such a label-fixing work. It keys out and puts names, at least down to genera, on the fauna of the between-tide zone of the shores of the British Isles. As she states herself: "Its object is three-fold: (1) To encourage observation of the habitat, habits and structure of the living animal, (2) To supplement with a closer observation in the laboratory, and (3) To provide a preliminary training in systematic work.

British land life is very meager because of the recent glaciation and the difficulty of spread from the south across the North Sea and the Channel and over mountain ranges that fringe the Mediterranean basin. The littoral fauna appears to have been less disturbed perhaps because of its association with the warm Gulf Stream and its direct connections with more southern continental shores. It is a fairly rich life. Comparative anatomy and systematic zoology started their modern development on these very shores. It was this fauna which enthused Cuvier when, as a tutor in the family of the Compte d'Héricy during the French revolution, he lived with that family at Fécamp near Havre on the Channel. His spare hours were spent collecting and dissecting these curious animals. The great English students of the invertebrates were trained on this same fauna.

The material is handled in thirteen Phyla. This conservative taxonomy is carried throughout the book. Thus the ninety per cent of common species are named to species while the accidentals, local and rarer forms, are not given specific treatment. Each phylum section opens with a short bibliography of monographic works on that group. Keys are moderately simple and anatomical terms are taken care of by numerous labels on the many plates of simple line drawings.

The volume gives the student a balanced picture of a North Atlantic seashore fauna. It is satisfying in this matter of putting labels on objects which are usually without names to even the seashore student of zoology. It is well done and by an experienced student of shore life.—*C. H. Kennedy.*

The Littoral Fauna of Great Britain, by N. B. Eales. xvii+300 pp. Cambridge, at the University Press; in New York, the Macmillan Co. 1939. $3.50.

SPIDERS AND INSECTS FOUND ASSOCIATED WITH SWEET CORN WITH NOTES ON THE FOOD AND HABITS OF SOME SPECIES

V. Homoptera and Summary

RAY THOMAS EVERLY
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HOMOPTERA

This order was represented in the field chiefly by the family *Cicadellidae*. However the determinations of this family have not been received and, rather than delay further the completion of this paper, it was decided to present the remaining species of this order. Determinations were made by Mr. J. S. Caldwell, Mr. W. D. Funkhouser, Mr. P. W. Mason and Mr. P. W. Oman.

APHIDIDAE

Aphis maidis Fitch—Ten specimens taken from July 28 to August 8. An undetermined species of aphids was observed upon an unopened tassel attended by *Formica fusca subsericea* Say, (Hymenoptera-Formicidae). When adult Coccinellid beetles were placed in the close vicinity of the aphids, the ants immediately rushed them and knocked the beetles from the plant.

CHERMIDAE

The specimens in this family have been previously reported by Mr. J. S. Caldwell in the Chermidae of Ohio. (Ohio Biological Survey Bulletin No. 34, Vol. VI, No. 5, Jan., 1938, pp. 241 and 235).

Aphalara veaziei Patch. . .One specimen collected July 10.
Livia opaqua Cald. . . . . .One male specimen taken July 18.
This specimen is the male holotype of the species.

CICADELLIDAE

Seventy-eight specimens were collected of this family representing an unknown number of species. Many were very abundant upon the corn plants. When, and if determinations for this group are received they will be presented in a separate paper.

DELPHACIDAE

Delphacodes sp. probably *lateralis* Van Duzee—One specimen taken July 31.

FULGORIDAE

Five specimens of this family were collected. These represented four distinct species. The accurate determinations of these can not be made as the specimens have become lost.

MEMBRACIDAE

Atmya querci Fitch.....One specimen taken July 6.
Campylenchia latipes Say...One specimen taken July 10.
Enchenopa binotata Say.....Three specimens collected July 11 and 12.
Micrutalis calva Say.....Two specimens collected July 10 and 11.
Similia camebis Fab.....One specimen taken July 5.

SUMMARY

This paper has presented a list of the species of insects and spiders collected within the limits of a four acre field of sweet corn. The list is far from a complete one due to lack of time to make more intensive collections and the limited collecting apparatus which could be carried, but it is a representative sample of the arthropod population of the field and is indicative of the tremendous numbers of species supported by the corn plants and the extraneous plants found in the field.

The four previous parts of this paper appeared as follows:

Part I—Arachnida and Coleoptera. Ohio Journal of Science, Vol. 38, No. 1, May 1938, pp. 136-148.

Part II—Ephemerida, Lepidoptera, Neuroptera, Odonata, Orthoptera, Thysanoptera, and Trichoptera. Ohio Journal of Science, Vol. 38, No. 6, Nov. 1938, pp. 311-315.

Part III—Hymenoptera. Ohio Journal of Science, Vol. 39, No. 1, Jan. 1939, pp. 48-51.

Part IV—Diptera and Hemiptera. Ohio Journal of Science, Vol. 39, No. 1, Jan. 1939, pp. 52-56.

Table I gives the distribution of the specimens collected among the various orders of spiders and insects.

In addition to recording the species present in the field, the following food plants and prey records were observed and collected:

ARACHNIDA

Phidippus sp. (immature).....Spider, *Tetragnatha laboriosa* Htz.

COLEOPTERA

Canthon pilularius L.....Horse manure.
Ceratomegilla fuscilabris Muls.....Plant bug, *Trigonotilus ruficornis* Geof.
Pollen of sweet corn.
Eggs of European Corn Borer, *Pyrausta nubilalis* (Hbn.)
Chrysopus auratus Fab.....Dogbane, *Apocynum cannabium* L.
Cicindela punctulata Oliv.....Ground beetle, *Tachys incurvus* Say (?)
Diabrotica duodecempunctata (F)....Anthers of wild rose.
Silk of sweet corn.

Epicauta pennsylvanica DeG.....Pollen of sweet corn.

Glisochrochilus quadrisignatus Say...European Corn Borer, *Pyrausta nubilalis* (Hbn.)

Tetragonoderus fasciatus Hald.....Black nightshade, *Solanum nigrum* Nutt.

TABLE I

Class and Order	Families	Genera	Species	Specimens
INSECTA:				
Coleoptera	27	105	145	963
Diptera	24	47	50	114
Ephemerida	1	1	1	3
Hemiptera	10	21	23	95
Homoptera	6	10*	13*	99
Hymenoptera	21	48	60	95
Lepidoptera	11	25	29	45
Neuroptera	2	2	4	10
Odonata	2	2	2	2
Orthoptera	4	8	9	26
Thysanoptera	2	2	2	2
Trichoptera	1	1	1	1
Total Insects	111	272	339	1,455
ARACHNIDA:				
Araneida	9	25	32	50
Grand Total	120	297	371	1,505

*Exclusive of Cicadellidae.

DIPTERA

Linnaemyia Rd. sp.....Exudations from tunnel of European corn borer in stalk of sweet corn.

Protacanthus milbertii Macq.....Bumble-bee, *Bombus impatiens* Cress.

Melon bee, *Melissodes bimaculata* LeP.; stinkbug, *Euchistus variolarius* P. de B.

HEMIPTERA

Euchistus variolarius P. de B.....Sweet corn plants (stalk).

Perillus bioculatus (Fab.).....Chrysomelid larva, *Lema trilineata* Oliv.

Nabis ferus L.....Plant bug, *Lygus pratensis* L.

HYMENOPTERA

Apis mellifera L. ..... Tassels and pollen of sweet corn.
Bombus americanorum Fab. ..... Tassels and pollen of sweet corn.
Bombus auricomus Robt. ..... Tassels and pollen of sweet corn.
Dinocampus coccinellae Schrank. ..... Reared from following three adult coccinellidae:
Ceratomegilla fuscilabris Muls.
Hippodamia convergens Guer.
Hippodamia parenthesis Say.
Prenolepis imparis Say. ..... Larva of European corn borer, *Pyrausta nubilalis* (Hbn.)
Sphex urnarius (Dahl.). ..... Lepidopteron larva, *Plusia* sp.
Telenomus podisi Ashm. ..... Reared from stinkbug eggs, probably *Euchistus variolarius* P. de B.
Zamicrotoridea syrphicola (Ashm.). ..... Syrphid larva, probably *Bacchus* sp.

LEPIDOPTERA

Acromycta oblinata (S. & A.) (larva). Sweet corn.
Anosia plexippus L. (larva) ..... Milkweed.
Ceramica picta Harris (larva) ..... Sweet corn.
Cirphis group. (larva) ..... Sweet corn.
Diacrisia virginica Fab. (larva) ..... Sweet corn.
Estigmene acraea Dru. (larva) ..... Sweet corn.
Geometridae sp. (larva) ..... Sweet corn.
Heliothis obsoleta Fab. (larva) ..... Sweet corn, leaves and ears.
Plusia sp. (larva) ..... Sweet corn.
Prodenia sp. (larva) ..... Sweet corn.
Prodenia ornithogalli Gn. (larva) ..... Sweet corn.
Pyralididae (*Pyraustinae*) sp. (larva). Sweet corn.
Pyrausta nubilalis Hbn. (larva) ..... Sweet corn, ears and stalks.
Vanessa atlanta L. (adult) ..... Fermenting exudations from tunnel of European corn borer larva in stalk of sweet corn.
Vanessa cardui L. (pupa) ..... Sweet corn.

NEUROPTERA

Chrysopidae sp. (larva) ..... Eggs of European corn borer *Pyrausta nubilalis* (Hbn.)

NOTES ON SUBTROPICAL PLANTS AND ANIMALS IN OHIO

CHARLES OTTO MASTERS
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SUBTROPICAL ALGAE IN OHIO

Throughout the year, the indoor pools of the William Tricker Company in Independence, Ohio, serve as a reliable source of subtropical aquatic plants and animals. Since the greenhouses are devoted to the propagation of waterplants and tropical fish, the water, within, is always kept above seventy degrees Fahrenheit.

Extremely interesting forms come and go but some of those which are not quite so ephemeral remain and can be observed at any time. For the last four years, collections of algae have been made there and we have usually been able to obtain fairly large quantities of a species which up until October, 1938, had been unknown to us.

Dr. Clarence Taft of Ohio State University identified the algae from a sample sent to him as *Compsopogon coeruleus*, one of the rarer members of the family, Rhodophyceae, or red algae. According to Gilbert Smith, the genus is one that has always been considered tropical or subtropical in distribution.

The occurrence of this species in Ohio was undoubtedly due to its introduction along with subtropical aquatics planted in the pools, and it is of especial interest to observe it in other local water gardens and aquaria throughout northern Ohio.

SPREAD OF A FRESH-WATER BRYOZOAN IN NORTH AMERICA

In January, 1934, while collecting brown hydra in the indoor water-lily pools of the William Tricker Company greenhouses the writer observed hundreds of small colonies of fresh-water bryozoa on the leaves of water plants and on the sides of the cement tanks. These were later identified as *Lophopodella carterii* from the article entitled "Studies on Fresh-water Bryozoa. 1. The Occurrence of *Lophopodella carterii* (Hyatt) in North America," by Mary Rogick of Ohio State University, which appeared in the October, 1934, issue of the Transactions of the American Microscopical Society. These first specimens

described and sent to the United States National Museum by Miss Rogick came from southwestern Lake Erie.

However, in Science (June, 1934), Professor Ulric Dahlgren of Princeton described the form which we suspected as being similar to those appearing in Independence as having been found four years earlier in the Delaware and Raritan Canal at Princeton, New Jersey. In the September, 1934, issue of the Ohio Journal of Science, the results of the collections made by Mary Rogick were published.

Since the bryozoa first appeared in the warm water of the greenhouse pools, they have become extremely abundant there covering many of the submerged flower pots, pipes, plants, and tank walls. Within a very short time, they appeared in the pools of the Buskirk Company of Independence. Later on they were observed growing in aquaria in other parts of northern Ohio.

Concerning the spread of this animal, it is of interest to consider the role played by the William Tricker Company which has imported aquatic plants from many tropical and subtropical areas throughout the world, and, in turn, has shipped them throughout the entire country. I have actually seen many plants covered with this beautiful form being sent to water-garden enthusiasts in various sections of the country. Interestingly enough, too, this same company has its main plant, seventeen acres of growing pools and greenhouses, located at Saddle River, New Jersey, the same state in which Dr. Dahlgren first described the bryozoan. As Dr. Dahlgren stated in his article, it is a clean form, and makes an extremely interesting inhabitant of an aquarium.

A New Manual of the Liverworts

For the student beginning the study of liverworts, this manual is the finest thing that has come to the attention of the reviewer. One hundred eleven species in fifty-six genera are described and illustrated. The descriptions are lucid and adequate. The line drawings are well-arranged on twenty-six plates and emphasize essential diagnostic characters. The key to genera and the keys to species are based in large part on vegetative characters enabling one, except in certain cases, to determine sterile specimens. Other interesting and useful features which might be mentioned are a list of abbreviations of names of authors of species and genera; a list of species names and their meanings; a glossary of terms used in the descriptions with references to illustrations on the plates; a bibliography including one hundred ninety-three titles. The book is well bound in cloth and contains remarkably few typographical errors.—*Richard T. Wareham.*

A Manual of the Liverworts of West Virginia, by Nelle Ammons. 164 pp. Notre Dame, The University Press. 1940. $1.75.

THREE NEW AUSTRALIAN ENCYRTID GENERA

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The following three genera comprise a part of A Systematic Monograph of the Australian Chalcidoidea, the manuscript of which is now in the archives of the Queensland Museum at Brisbane. The manuscript is foolscap and of over 2,000 pages; and though containing a bibliography has not as yet been indexed. Despite this lack of index, a very necessary and exceedingly useful part, the Monograph contains complete diagnoses of the genera and species of the group, together with many as yet unpublished new descriptive notes, corrections and so forth. It corrects and consolidates all the matter so far published upon and gathered to date, about the group as it occurs upon the continent of Australia (including adjacent coastal islands).

Gounodia new genus. Ectromatini

Like the genus *Epistenoterys* except that the frons is not prominent, it is wide and the scape is flat but not dilated. Palpi exceptionally for the tribe, 1- and 2-jointed.

Gounodia mellea. Genotype, new species

Yellow, the legs, the club of the antennae and the basal two-thirds of the ovipositor, pale. Metatarsus exceeding the middle tibial spur but not half the length of its tarsus (leg No. 3). Ovipositor a third the length of the abdomen. Fore wing bearing 7–8 lines of discal cilia proximad of the hairless line. Joints Nos. 1–5 of the funicle a bit wider than long, the pedicel longer, twice longer than widest. The male is described in MS. A male and three females reared from *Sphaerococcus tomentosus*, Perth, West Australia, L. J. Newman.

Bachiana new genus. Ectromatini

This genus is like the genus *Pseudanusia* except that the first joint of the funicle is ring-like (as in some genera of the Mirini).

Bachiana curiosa. Genotype, new species

As *Phauloencyrtus mirisimilis* except the mandibles; and the knees, tibial tips, a cinctus upon the long middle femora near the base, are white; ovipositor half the length of the abdomen; scape slender, black,

the joints of the funicle after the first, subquadrate. A male and two females reared from *Mytilaspis cordylinidis*, Perth, West Australia, L. J. Newman.

Compare with the following genotype with which it was for some time confused. The two are remarkable similitudes.

Phauloencyrtus new genus. Mirini.

Like *Pteromalencyrtus* but the mandibles small and acutely 3-dentate, strong, the middle tooth somewhat longest; abdomen short and triangular. Eyes very pilose. Middle tibial spur not elongate, distinctly shorter than joint No. 1 of the second tarsus. In my modernized table, runs next to *Ceraptrocerus*. But the first joint of the funicle is ring-like, the flagellum not flattened.

Phauloencyrtus mirisimilis. Genotype, new species

As *Pteromalencyrtus* genotype but the fore wing dusky at base; there is a line of cilia along the submarginal to base; and the two well-separated lines proximad of the hairless line are joined caudad, running to wing base; vertex with short setae, frons moderate. Spiracle of the abdomen at basal third, the abdomen as long as wide at base. Gordonvale, Queensland.

I ought to state, in this connection, that the Monograph noticed above also contains a complete new classification of the Chalcidoidea based upon Ashmead, a classification of the families and their divisions. Ashmead had long since laid the foundation for the proper classification of this great group but it has been very badly stated and was confused. A reduction of one or two families is indicated. Ashmead was overburdened and did not live long enough to state his views clearly.

The Newest Things in Science

This excellent little volume summarizes the advances in various fields of science for 1939. This alone would make it valuable, but in addition brief histories of the developments leading to each new discovery are given, adding immeasurably to the value of the book. The subjects include plant hormones and other phases of growth, cancer, shock treatment of schizophrenia, sex and sex hormones, television, atom-smashing, chemistry, astronomy, and others. The style is popular and very readable, but nevertheless accurate and not too simplified. The book should be a fine reference work for anyone interested in science.—*L. H. S.*

Science Front, 1939, by F. S. Taylor. 301 pp. New York, the Macmillan Co. 1940. $2.50.

A COMPARISON OF PLANKTON COUNTS FROM THE TRAP-NET AND WATER BOTTLE CENTRIFUGE TECHNIQUES

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INTRODUCTION

Quantitative plankton methods have been the subject of considerable study, but many workers making routine plankton counts have concerned themselves little with problems arising out of certain common techniques.

In a study of collections with the Birge quantitative, closing, plankton tow net (Kraatz, 1931), the writer made counts under binocular in the entire Sedgwick-Rafter counting cell, not only of zooplankton such as Entomostraca and Rotifera, but also of as many others of somewhat smaller size as feasible; and as usual, counted the smaller plankters on microscope (16 mm. objective and 7.5 ocular) with Whipple ocular micrometer in 20 squares, multiplied by 50 to get the cell counts. For plankters counted both ways, where numbers involved were small, the numbers secured by multiplying were almost invariably larger, often much larger than the whole cell counts, which were correct. One can conclude that the larger the portion counted of any kind of plankter in the cell, the more accurate the results.

In the present paper while the same comparison is in the background, the principal comparison is between counts of organisms collected by the trap and the water bottle.

The main objectives of the writer's investigation, the seasonal and other plankton distribution, will be presented in another paper, where also will be given records of temperatures and chemical tests. There also acknowledgments will be made to all those who assisted in the collection and otherwise.

Realizing after studies were made that statistical checks on apparent discrepancies of trap-net and water bottle centrifuge counts would be important, the writer entirely uninformed in such matters, secured the aid of Dr. Wm. E. Ricker, who gave most valuable information in personal communications and in his papers (Ricker 1937, 1937 (a), 1938) to which readers should refer for explanation of statistical methods in plankton work.

COLLECTING METHODS

Collections were made in Turkeyfoot Lake, near Akron, Ohio, from August, 1936, to March, 1939, with unavoidable omission of certain winter months. The Foerst plankton trap, 10 liters capacity, having cone net and bucket of No. 25 silk bolting cloth, as on the Birge net and the Kemmerer-Foerst brass water bottle, 2 liters capacity, both donated by the Ohio Division of Conservation, were used in collecting.

Trap samples, 10 liters, were uniformly concentrated to vial samples of not quite 40 c. c. Water bottle samples were uniformly one liter; the other liter was used for chemical tests. The one liter used was thoroughly representative of the two liters collected.

DISCUSSION OF COLLECTING METHODS

The trap-net is better than the net alone, in that it obviously collects a known quantity of water, but is subject to the same losses of small organisms through meshes of the concentrating net. The net used was old and had previously shrunk, (as new cloth will shrink in water) and the meshes were to some extent clogged.

Most water bottle plankton collections have been one or two liter samples. It is impracticable to carry a set of bulky ten liter or even five liter sample bottles. Larger samples would give theoretically better representation of lake population, a point considered negligible by many workers, especially when they count only the smallest plankton from the water bottle.

LABORATORY METHODS

Preservation of trap samples was accomplished at once by having about one c. c. of formaldehyde in the vial when collection was made. In the laboratory a little distilled water was added to make each trap sample exactly 40 c. c. later as the sample was to be examined. After thorough agitation one c. c. was put in the Sedgwick-Rafter counting cell.

The one liter water bottle samples were not preserved initially, but immediately after return to the laboratory they were centrifuged, each in about 7 minutes for one centrifuging, as advised by Foerst, and by Juday. The Foerst electrically run water centrifuge has an r. p. m. of 15,000. The plan of two centrifugings for each sample was adopted. Distilled water was added to the residue to wash it out of the cup of the centrifuge. Later for examination the samples were uniformly made up to 20 c. c.

In a great deal of other plankton work, counting cell samples from the trap-net were examined for so-called net plankton and from water bottle, for the so-called nannoplankton or dwarf plankton. In recent Ohio Conservation Division work trap samples were examined for zooplankton and water bottle samples for phytoplankton, which is efficient from the standpoint of two observers working with the separate samples and makes for a biological division of groups desired.

The writer decided to examine trap samples for all plankton and water bottle samples likewise, to secure a check if possible, comparing the two collecting and concentrating techniques. For both, the one

c. c. in the counting cell on low power binocular, × 48, with aid of mechanical stage, was counted completely for Entomostraca, Rotifera and also others like Ceratium, when feasible, and then the smaller more abundant forms were counted in 20 squares of the Whipple ocular micrometer, on the microscope with 16 mm. objective and 7.5 ocular. Therefore, a comparison of samples from trap and water bottle could be made.

Due to the particular size of the samples, the trapnet count, when of the whole cell as for larger plankters, represented ¼ of a liter, but when counted in 20 squares (multiplied by 50 to get the total) the actual count was of 1-200 of a liter. For the water bottle the two counts represented 1-20 of a liter and 1-1000 of a liter respectively.

DISCUSSION OF PLANKTER SIZE IN RELATION TO COLLECTION AND CONCENTRATION METHOD

It has long been recognized that even the finest mesh tow nets allow the smallest plankton organisms to escape and that if the plankters are very slender long colonies or individuals, they might be retained in variable degree, but could if exactly endwise pass through the net meshes. The organisms too small to be collected by net, the nannoplankton, are collected by water bottle.

But to count zooplankton only from trap samples and phytoplankton only from water bottle centrifuged samples, seems arbitrary, especially since many Protozoa would belong to nannoplankton, and on the other hand, many plant colonial types, larger Cyanophyceae and Chlorophyceae and some diatoms are net plankton.

A separation of net plankton and nannoplankton on basis of size is essential, but it does not seem feasible to maintain exact size difference as indicated by Welch (1935, p. 208). A separation on basis of kinds, species or genera, though not necessarily accurate, seems practicable.

In most routine work genera alone can be listed. It is notable that Birge and Juday (1920, p. 60) list in net plankton, besides Entomostraca and Rotifera, the following: Ceratium, Microcystis, Coelosphaerium, Aphanizomenon, Anabaena, Lyngbya, Staurastrum, Melosira, Tabellaria, Fragilaria, Asterionella, Stephanodiscus, but again among nannoplankton, p. 90, list Coelosphaerium, Stephanodiscus, fragments of Aphanizomenon, but also thirteen other genera of algae and Rhizopoda and Ciliates.

Turkeyfoot plankton includes prominently a large type of Coelosphaerium, large Anabaena, and also considerable Microcystis and abundant Aphanizomenon. The latter is a more slender filament than the Anabaena. All these, and also the diatoms Asterionella, Synedra, of large size, and Fragilaria, occurred prominently in trap-net samples showing very typical development and decline periods during a year. However, certain comparisons of net and centrifuged samples will be made later.

In contrast to the above which can be termed net plankton, there were found at certain times a very much smaller kind of Synedra, a very tiny filament identified as a small Oscillatoria, a smaller type of Coelosphaerium, Trachelomonas, and in just two collections one fall

a tiny diatom Amphora. Practically none of these were revealed in trap-net samples. They occurred in centrifuged samples, and whenever they did, especially the tiny Synedra, and Oscillatoria and Amphora, in enormous numbers.

But nannoplankton have not been revealed adequately in this study, despite water bottle collections, due to limitation of practicable magnifications. The Sedgwick-Rafter counting cell and Whipple micrometer permit only work with 16 mm. objective and 7.5 ocular. For identification occasionally a 12.5 ocular was substituted, but all counts made with 7.5 ocular. No examination was made of a drop mount under thin cover glass and high powers. Dr. C. E. Taft identified many smaller algae and Dr. L. E. Noland some small Protozoa. Dr. Noland pointed out the difficulty of identification of preserved ciliates and others. While these types were numerous, most did not occur in great numbers relatively and it was found impossible to consider and count them in the routine work. The total quantity of nannoplankton, however, would be enormous.

The nannoplankton can be omitted from this paper as the comparisons are essentially of net plankton, as revealed in the two different collecting and concentrating techniques.

LOSSES IN CENTRIFUGING

The centrifuging process tended to break up some larger filamentous colonies, especially Anabaena, making it harder to count the colonies. Asterionella maintained its star-shaped arrangement remarkably well, except in a few instances. A few others were sometimes broken, most surprisingly the hard-shelled Ceratium. Sometimes its points were broken; sometimes it was broken in two across at the groove.

A worse feature was the loss of some blue-green algae over the top of the small inside cup of the centrifuge so that they went with the overflow water instead of the sample. The large Coelosphaerium and the Anabaena were lost in large degree, Microcystis to nearly the same extent, Aphanocapsa, somewhat less and Aphanizomenon usually was not lost. This will be again brought out in the tables. Dr. Juday wrote me that he had little trouble of this sort in his long experience, except with Aphanizomenon.

The centrifuge was working well. A stroboscope test on the empty centrifuge showed not far below 15,000 r. p. m.

Coelosphaerium and Anabaena are low in specific gravity, especially when more or less in condition of water bloom, but less so in colder weather when numbers are low. They tend to gather in the top layer of water. In one case a liter bottle purposely left standing for some time before centrifuging, showed a thin line of these gathering on the water surface. In the case of the net condensed vial samples, a dense layer of from one to two mm. thick would form on the top of the four-inch column in the vial. At the same time other plankton tended to sink to the bottom. Even in counting cell samples, in a very short time after making the cell mount, these same blue-greens would tend to come up to the cover glass. To be sure, the net samples in the vials and all samples on the microscope were preserved, but the preservative

was a slight amount compared to the water volume. And it must be repeated that material in samples at centrifuging was alive.

Every sample was centrifuged twice. Nevertheless, as shown in the tables, nearly all these blue-greens were lost in centrifuging. More centrifuging was not feasible in routine work. But a test case was made in which one liter was centrifuged five times. Lengthy examination showed ample Coelosphaerium and Anabaena in overflow water, but none in the sample after the first centrifuging. Again in each of the subsequent centrifugings of the same overflow water, large but decreasing numbers were indicated in the overflow water, and but slight increases in the successive samples, but a fair improvement in the last. It is surprising that there should not have been more improvement, especially since all other organisms were successfully removed the first time. A trap-net sample taken at the same time and place as the above centrifuged sample, proved a rich supply of these blue-greens present.

REPRESENTATIVE PLANKTON COMPARISONS

DISCUSSION OF TABLES

In the tables the most direct comparison is between counts of plankton collected by trap and collected by water bottle, the method of concentration being by net as compared with centrifuge, indicated by "net" and "centr." respectively.

TABLE I

CYANOPHYCEAE

Numbers in 1 Liter of Turkeyfoot Lake Water, June 19, 1937

Organisms	Surface Water		4 Meters		8 Meters		12 Meters	
	Net	Centr.	Net	Centr.	Net	Centr.	Net	Centr.
Coelosphaerium	4,100	460	5,200	1,320	1,400	180	896	1,520
Aphanocapsa								
Microcystis	800		600	380	400	60	236	140
Oscillatoria								
Anabaena	8,000		6,800		1,400		1,272	
Aphanizomenon	153,600	337,000	183,200	391,000	25,200	8,000	37,000	150,000

Tables II and III. All main groups, represented by the chief plankton organisms found more or less throughout the collecting period, are included. Of these the green algae were least common. Many other kinds were found from time to time. All types included are net plankton, though some are not so perfectly collected by net.

Certain nannoplankton were counted, but as previously explained, they are omitted as being outside the scope of this paper.

Cyanophyceae.—Tables I, II and III. A glaring lack in centrifuged samples (as described above) of Coelosphaerium, Anabaena, and the less common Microcystis is seen. This applies less fully to the Aphanocapsa.

TABLE II

CYANOPHYCEAE AND OTHERS

Numbers in 1 Liter of Turkeyfoot Lake Water, July 19, 1937

ORGANISMS	SURFACE WATER		4 METERS		8 METERS		12 METERS	
	Net	Centr.	Net	Centr.	Net	Centr.	Net	Centr.
Coleosphaerium	4,000		4,400	1,450	2,200		4,400	75
Aphanocapsa	1,400		1,200		200		1,200	
Microcystis	3,600		2,400	1,250	1,400		2,400	
Oscillatoria				1,250			200	
Anabaena	65,600	5,000	49,607	7,500	10,400		42,800	
Aphanizomenon	18,400	232,000	34,400	46,250	4,800	2,500	20,400	
Melosira	1,000	3,000	800	1,250	1,800	5,000		1,250
Synedra								
Asterionella								
Fragilaria	800	3,000	600	5,000			200	1,250
Stephanodiscus	1,200	1,000	1,000		2,400		3,000	
Staurastrum	36		40	150	80		100	
Pediastrum	20	40				75	24	
Ceratium	4,940	760	2,964	175	644	150	656	50
Polyarthra	492	540	144	150	12			
Keratella	324	460	656	425	192	325		
Synchaeta								
Asplanchna								
Notholca	92	100	12	75	8	75		
Nauplius	108		96	50	60		96	25
Cyclops			24	25	12		8	
Diaptomus			8		4		4	
Daphnia	12	20	8	25			4	
Bosmina								

However, the very abundant Aphanizomenon is frequently well centrifuged. Table I shows twice as much in centrifuged surface and 4 meter samples as in trap-net samples, but an inconsistency at 8 meters and again a relatively very high count at 12 meters. Table II shows the same situation, but with a peculiar total absence of centrifuged spec-

imens at 12 meters. One might on the whole conclude that centrifuging was definitely the better method and that the net lost many. But Table III shows no such discrepancy between the two concentration methods.

TABLE III

CYANOPHYCEAE AND OTHERS

Numbers in 1 Liter of Turkeyfoot Lake Water, June 18, 1938

ORGANISMS	SURFACE WATER		4 METERS		8 METERS		12 METERS	
	Net	Centr.	Net	Centr.	Net	Centr.	Net	Centr.
Coelosphaerium	400		1,000		400		150	
Aphanocapsa								
Microcystis								
Oscillatoria								
Anabaena	10,600	1,000	9,800	1,000	9,800		800	
Aphanizomenon	9,600	6,000	8,600	8,000	5,400		200	
Melosira								
Synedra								
Asterionella			200		600	21,000	7,200	30,000
Fragilaria	600		200		200			
Stephanodiscus								
Staurastrum								
Pediastrum	800	60	48		28	80	32	
Ceratium	24,800	26,000	16,400	20,000	22,240	19,000	3,744	2,000
Polyarthra	156	20	156	60	296	100	124	
Keratella	36	40	20		48	40	36	
Synchaeta								
Asplanchna	16		24		12			
Notholca								
Nauplius			52	80	52	100	36	20
Cyclops			8	20	16		4	20
Diaptomus			24	20	48	60	8	
Daphnia	4		16		52		4	
Bosmina					4			

Statistically considered, the discrepancies of various sizes can be evaluated. Following methods elucidated by Ricker (1937, p. 74) and furthermore applied by him to certain of my examples in personal letter, a simple illustration can be given of Anabaena and Aphanizomenon in Table III.

The members per liter for the four depths can be added. This tabulation follows:

	Per Liter	Actual Count	Limits of Confidence	Confidence Limits per Liter of Lake Water
Net	30,100	155	132 to 181	26,400 to 36,200
Centr.	2,000	2	0.2 to 7.2	200 to 7,200

In the possible statistical ranges there is no overlapping whatsoever for the two methods. In other words, these discrepancies are proven significant, and it is positive that the centrifuged samples are of no value in the case of Anabaena. In the case of Coelosphaerium the same thing would be demonstrated. In corroboration was the evidence described previously of the losses in actual centrifuging.

But in Aphanizomenon, the picture is different.

	Per Liter	Actual Count	Limits of Confidence	Confidence Limits per Liter of Lake Water
Net	23,800	119	99 to 142	19,800 to 28,400
Centr.	14,000	14	7.7 to 23.5	7,700 to 23,500

These differences are not actually significant, because of overlapping of the statistical ranges secured from the two concentration methods.

To be sure, if Aphanizomenon counts of Tables I and II were taken as examples and similarly worked out, we would find in the statistical ranges of limits of confidence per liter of lake water of the two techniques, a real significant difference, but the centrifuge is higher.

Conclusions regarding Aphanizomenon are consequently difficult to make. Sometimes some seem to be lost in centrifuging, though generally not, and some may pass through the net, depending possibly upon massing of the filaments, if more isolated, passing through more freely.

The other plankton organisms of Tables II and III can be quickly compared. These and a score of others of the same station show innumerable small differences in counts calculated to numbers in one liter when net and centrifuge results are compared. The many differences found were disconcerting during this study, but statistical analysis will show most of them of little significance.

Diatoms when very abundant as in the normal spring maximum offer another problem. Tables IV and V demonstrate that while the net collection numbers are large and seem to show successful collection, with huge numbers and normal rises and declines in various parts of the year, the centrifuge numbers are, though practically only at the height of the season, still far greater than the net totals. At the maximum, a significant difference is proven, as in Asterionella, 1937, (Table IV) and Synedra, which, however, never attains the numbers of Asterionella at its maximum. In 1938 (Table V) Synedra reveals the same picture and even greater numbers, but Asterionella is relatively low

compared with a year before, and oddly the discrepancy between net and centrifuge counts is not so pronounced. But one month later, May, 1938, Asterionella reached a maximum though not duplicating that of April, 1937, but with the same discrepancies between net and centrifuge. Possibly when the numbers become enormous, more are pushed through the net meshes.

TABLE IV

DIATOMS

Numbers in 1 Liter of Turkeyfoot Lake Water, April 24, 1937

ORGANISMS	SURFACE WATER		4 METERS		8 METERS		12 METERS	
	Net	Centr.	Net	Centr.	Net	Centr.	Net	Centr.
Melosira	150			1,000	600			1,000
Synedra	7,650	21,000	4,400	27,000	3,000	18,000	2,600	31,000
Asterionella	140,100	856,000	136,200	1,139,000	126,000	955,000	94,400	811,000
Fragilaria	1,050	3,000	600	5,000	1,000	6,000	1,400	4,000
Stephanodiscus	600	2,500	300					3,000

TABLE V

DIATOMS

Numbers in 1 Liter of Turkeyfoot Lake Water, April 16, 1938

ORGANISMS	SURFACE WATER		4 METERS		8 METERS		12 METERS	
	Net	Centr.	Net	Centr.	Net	Centr.	Net	Centr.
Melosira	1,000		1,200		1,200	1,000	2,000	1,000
Synedra	45,000	64,000	50,200	76,000	55,000	224,000	40,600	178,000
Asterionella	18,200	12,000	26,000	13,000	15,400	19,000	19,000	3,000
Fragilaria	200	1,000	800	1,000	24		200	1,000
Stephanodiscus								

Entomostraca, being relatively gigantic plankton and also rotifers, are not present in such great absolute numbers, but do show normally large populations. There are no very significant differences between net and centrifuged records, though in some cases Entomostraca are missing in counts of centrifuge sample when present in small numbers in net samples, showing that the 1 liter water bottle sample is rather too small.

On the other hand, sometimes the centrifuge number, a round number, appears larger. This does not indicate that the centrifuge collection is better. Indeed it is less accurate than the net collection because based on fewer actual counted specimens and involving more

multiplication in the calculation. For example, (Table III) Nauplius at 8 meters has 82 in net sample and 100 in centrifuge sample. Actually, 13 were counted in the one c. c. from the 40 c. c. net sample; multiplied by four, showed 82 in a liter. But only 5 were actually counted in the one c. c. of the 20 c. c. centrifuge sample; multiplied by 20, would show 100 in a liter. The 100 is less accurate and probably a little too large.

Similarly in counts of smaller organisms when counted in 20 squares, when still more multiplication is necessary. For example, Fragilaria in Table II, at surface shows 800 in net and 3000 in centrifuge samples. Naturally, there is no proof in this case that some might not have gone through the net. In net sample 4 were counted in 20 fields; $4 \times 50 \times 4$ yields 800, the liter number. In the centrifuge sample 3 were counted in 20 fields; $3 \times 50 \times 20$ yields 3000, the liter number. In various scattered cases occur instances of appearance of 1000 supposed individuals per liter in centrifuge samples, in each case based on only one actually counted in the 20 squares of the cell. Invariably in those cases, the number 1000 is larger than the calculated number in net sample. Mostly the differences are small and not statistically significant. Nevertheless, it is more than a coincidence that such centrifuge numbers are larger than the respective net numbers. They are somewhat less accurate.

In plankton work, samples at least several times larger than one liter are advantageous, because in the small residual samples counted, there will be represented a larger liter fraction that is actually counted. Naturally the counting cell sample must not be too concentrated for accurate counting. Between any two samples secured by 2 collecting techniques, that sample is better which has a larger volume of its water surveyed and more of its plankters counted, and which requires the least multiplying to get the number per liter.

This is important, but it is not an indictment of the water bottle as such, but of the relatively small size bottle ordinarily used, as compared with the trap.

SUMMARY AND CONCLUSIONS

Plankton collections made with trap and with water bottle have ordinarily been handled as two separate entities with mutually exclusive groups of organisms counted from each.

In this study all plankton (except some obvious nannoplankton) was studied and compared throughout from trap and water bottle samples.

The comparison served as a check of the two methods, theoretically valid throughout the range of net-plankton.

Some organisms are difficult to classify into net plankton or nannoplankton.

The net (as is well known) allows real nannoplankton to pass through its meshes.

The water bottle (as is well known) retains all nannoplankton.

Many small differences occur between samples concentrated by the net and by the centrifuge, though most of these are not statistically significant.

Water bottle samples as made in this study and frequently otherwise, are too small in quantity compared with the 10 liter trap samples. If the bottle samples were larger there would be more and more offset to the disadvantage next listed.

The larger the portion of any collected sample which has its plankton actually counted and the less multiplication required to secure numbers per liter, the better the results. In that sense the trap-net samples are better than the centrifuge samples when done in the manner described.

The centrifuging process at 15,000 r. p. m. introduces some problems, in breaking up some organisms, thus adding to inaccuracy of counts, and moreover in failing to retain in the centrifuged sample, many important blue-green algae of low specific gravity, especially of the summer collections.

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So You Plan To Write a Book

This compact little guide is one of the most valuable books that has fallen to my lot to review in many a month. It is an informal but straight-from-the-shoulder discussion of the provinces, properties and responsibilities of authors, publishers and printers. From the would-be author to the seasoned veteran and the experienced editor, those who have to do with writing for publication will derive untold benefit from a careful study of its pages. Yet "study" is hardly the word, for not only is the book crammed with meat, but it is so delightfully written that the conclusion is almost inescapable that Mr. Gill missed his calling in being a publisher: he should have been an author.—*L. H. S.*

The Author Publisher Printer Complex, by Robert S. Gill. iv+76 pp. Baltimore, the Williams and Wilkins Co., 1940. $1.00.

Zoology of the Invertebrates

The introductory volume of the first American treatise on invertebrate zoology has just appeared. Doctor Hyman has proposed to write a series of several volumes and the first one is concerned with Protozoa, Mesozoa, Porifera, Cnidaria, and Ctenophora. Hyman's treatise is unusual, when compared to other works of its range, in that it is being written by one individual. The author has relied heavily on the literature and in this connection it is gratifying to see that the literature of all countries has been consulted with care and recent reports are represented. However, she herself has published well known researches on two of the phyla and has made original observations on two others and writes, therefore, with the experience of first-hand information. The large variety of species considered in detail (the "type" method is not used) covers the variations within each phylum and necessitates a well planned presentation of the numerous facts so as to avoid confusion and repetition. The morphological phase of zoology is particularly evident in more than 1,600 good illustrations, and animals as organized living units are well represented by abundant information on their embryology, physiology, ecology, and life histories. An excellent index enables one to locate subjects readily. There are three chapters, in addition to the five which treat the phyla named above, which deal with Protoplasm, the Cell, and the Organism; Classification; and Introduction to the Lower Metazoa. These chapters are valuable in abundance of factual material. Throughout her book and especially here, the author thoroughly discusses and carefully evaluates zoological theories, many of which have become confused with facts. The precise style of writing, freshness and completeness of material, and logical handling of doubtful and theoretical topics, all indicate that the volume will serve admirably for a textbook and for reference. It is not hazardous to predict that the usefulness of this book will be enormous.—*Carl Venard.*

The Invertebrates—Protozoa through Ctenophora, by Libbie Henrietta Hyman. ix+726 pp. 221 figs. New York, the McGraw-Hill Book Co., Inc., 1940. $5.50.

Van Nostrand's Scientific Encyclopedia

This comprehensive compilation of scientific information has as its objective the coverage of fundamental and technical principles in the following twelve fields: Chemistry, Physics, Mathematics, Engineering, Astronomy, Medicine, Mineralogy, Aeronautics, Navigation, Geology, Zoology and Botany. It is clearly and concisely written. The subject matter included shows evidence of having been carefully selected and is well illustrated by a large number of diagrams and photographs. By way of less favorable criticism it seems unfortunate that in the table on page 242 the molecular volume is given as 22.2 liters whereas the generally accepted value is 22.4 liters; also on page 1090 the use of the admittedly imperfect analogy of an inflated rubber balloon in the discussion of Surface Tension might well be omitted in the interest of clarity and accuracy. On pages 452–3 under Feedwater Treatment the technical water items are good but suffer somewhat by the absence of a discussion of the modern anion exchange reactions. In this section near the bottom of page 453 the statement, "Foaming results also from the saponification of the boiler water . . .", makes a rather curious use of the phrase "saponification of water," inasmuch as water is not saponified. Further, on page 1127 under the discussion of "Three-Phase Equilibrium" . . . (See *Slblimation*) . . ." should read *Sublimation.* Generally, however, as one uses this Encyclopedia he is favorably impressed by its relative freedom from error and by its up-to-date character. It will undoubtedly find its greatest value, not as a supplementary source of information for the specialist in a given field, but rather as a ready and convenient reference for him in other and less familiar fields. The book is attractively and durably bound, printed clearly on good stock and should stand up well under a great deal of use. The authors of this work have accomplished their main objectives in a very satisfactory manner and the book should prove to be a valuable addition to scientific literature.—*Wesley G. France.*

Van Nostrand's Scientific Encyclopedia. 1234 pp. New York, D. Van Nostrand Company, Inc. 1938. $10.00.

AN ECOLOGICAL EFFECT OF THE NEW ENGLAND HURRICANE

MARY D. ROGICK
College of New Rochelle

On September 21, 1938, a hurricane and an unusually high tidewater struck the general region of Woods Hole, Mass.[1] In addition to destruction of life and property, disruption of transportation and communication, etc., there was a distinct effect on the ecology of the region. Frequently during the summer of 1939 there was brought to the attention of the

Text Fig. 1. View looking toward the Nobska Light House (center) at Woods Hole, Mass. A road and a few yards of shore separate the Fresh Water Pond (on the left) from the sea (at right). The bathhouse shown at the extreme right next to the cars was washed into the Fresh Water Pond across the road during the hurricane.

students at the Marine Biological Laboratory the fact that the collecting sites showed some changes regarding the quantity and kinds of organisms available, as compared with collections made during the summers of previous years, before the hurricane. Moreover, some of the fresh-water ponds which were in the low lands near the seacoast became salty or brackish because they were flooded with sea water during the hurricane.

[1]Scientific Monthly, Jan. 1939, pp. 42–50.

The present article deals with such a pond which temporarily at least is brackish. It is known as the Fresh Water Pond and is located in Woods Hole just northwest of the Nobska Light House. This pond is on low terrain only a few yards away from the sea (Text fig. 1). Its bottom is somewhat variable, being of a sandy, rocky and muddy nature, depending upon the part of the pond examined.

Collections of specimens, particularly of Bryozoa or moss animals, were made in the pond several times during the summers of 1938 and 1939. During the summer of 1938, before the hurricane, fresh-water Bryozoa *Fredericella sultana* and *Plumatella* sp. were found growing quite abundantly on the lower surfaces of submerged rocks. When collecting during the summer of 1939, i. e., after the hurricane, the writer was struck with the fact that all fresh-water Bryozoan colonies found on the rocks were the previous year's growth and dead. Diligent search failed to disclose a single living colony of *Fredericella* or *Plumatella*. However, growing directly beside some of these killed but still attached fresh-water specimens were found living barnacles and live, thriving colonies of a salt or brackish water Bryozoan *Membranipora lacroixii*.

The outer chitinous covering or ectocyst of the *Fredericella* and *Plumatella* colonies which remained after the softer parts of the animals had disintegrated was quite sturdy and well cemented to the substratum (Plate I, fig. 5). It was in a good state of preservation. The seed-like reproductive bodies called statoblasts which characterize most of the fresh-water Bryozoa were firmly attached either to rocks or inside the zooecial tubes. A large percentage of the statoblasts were normal in shape or size but several somewhat atypical ones were found and are here figured (Figs. 2, 3, 4). That there is considerable variation in statoblasts is well known to all who have had the pleasure of working with this group.

The salt water species found in the pond the summer after the hurricane was somewhat difficult to name because its synonymy is in a considerable state of confusion. However, Dr. R. C. Osburn in 1910 reported the occurrence of *Membranipora lacroixii* from Buzzards Bay. Since the present pond specimens seem identical with his *M. lacroixii* figures (1910, U. S. Bur. Fish., Bull. XXX, Pl. 22, fig. 28) his terminology is being followed. This Bryozoan forms a delicate white calcareous meshwork or tracery on rocks. The extent of the colony is

varied, depending partly upon age. The largest colony observed was approximately 7 centimeters in diameter. It was collected on September 3, 1939. One rather unusual feature about this colony was that it was growing over fragments of the previous year's *Fredericella* and *Plumatella* colonies which were still attached to the rock.

The smoothness of the substratum on which the colony grows influences to some extent the shape of the zooecia or "cases" in which the individuals are housed. Zooecia growing on a fairly smooth or flattened surface are shaped like those pictured in Figure 9, being quite regular and longer than wide, while those growing over crevices or irregularities may be irregular, pyriform or long and very narrow. The following zooecial and opesial measurements were made on 14 regular zooecia, while the operculum measurements were made on only 4 specimens.

TABLE I

	Maximum in mm.	Minimum in mm.	Average in mm.
Zooecial length	0.52	0.42	0.476
" width	.31	.26	.291
Opesial length	.46	.34	.413
" width	.26	.20	.226
Operculum length	.11	.10	.103
" width	.13	.09	.111

Ovicells and avicularia are lacking. The oral arch is slightly raised and is higher than the rest of the zooecium. Opesia large and elliptical bordered by a narrow, raised, granulate or finely tuberculate rim, some of the delicate processes of which project into the opesia. Several multiporous rosette plates, generally 3 but occasionally as many as 6, may be found in the lateral wall (Figs. 6, 8). The operculum is slightly wider than long, with a chitinous rim reinforcing its edge. The rim is about 15 to 25 micra wide. The operculum is not calcified.

It would be an interesting problem to watch the pond for the reappearance of the fresh-water forms *Fredericella* and *Plumatella* and for the disappearance of the brackish *Membraniporan* species and for succession of organisms over a period of several years.

EXPLANATION OF PLATE I

Figs. 1, 2, 3 and 4. Variously shaped statoblasts (reproductive bodies) of the fresh-water form *Fredericella sultana*. The last three are quite atypical.

Fig. 5. A fragment of a 1938 *Fredericella* colony (dead) collected in late summer of 1939 and showing several empty zooecial tubes (*Z*).

Fig. 6. Fragment of 2 zooecia of *Membranipora lacroixii* (brackish or salt water form) showing 4 rosette-plates (*R*) in the lateral walls (*L*) and a thinner section (*Y*) of the dorsal wall which was observed more clearly on one specimen than on any others. *OE* refers to the large opening or opesium. Part of the lateral wall and opesial border are torn away in this specimen.

Fig. 7. Part of a zooecium of *M. lacroixii* showing the operculum (*O*) which has a distinct chitinous border (*K*). The zooecium is slightly different in shape from those in Fig. 9, but is not at all unusual. Individuals with 2 spine-like processes (*I*) near the oral arch (*OA*) were very rare, occurring only in a few zooecia of a young colony. Some of these processes were jagged and less like hooks than in present figure. *U* refers to the delicate processes projecting into the opesium from the calcareous wall.

Fig. 8. Section of a lateral wall (*L*) of *M. lacroixii* showing a rosette-plate or pore-plate in greater detail than in Fig. 6.

Fig. 9. Section of a colony of *M. lacroixii* showing a number of ordinary zooecia (*Z*) and a rudimentary one. The opercula and membranes covering the zooecial openings have been burned off to show the zooecial outlines more clearly. Abbreviations same as for preceding figures.

Fig. 10. All the preceding figures were drawn with the aid of a camera lucida. The scales for the various figures are here given: Scale *A* for Figs. 1 to 4, *B* for Fig. 6, *C* for Fig. 7, *D* for Fig. 8 and *E* for Fig. 9.

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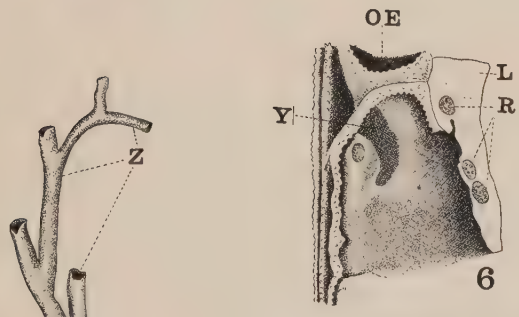
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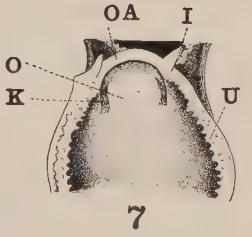
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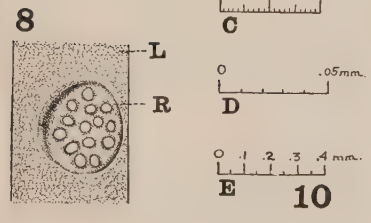
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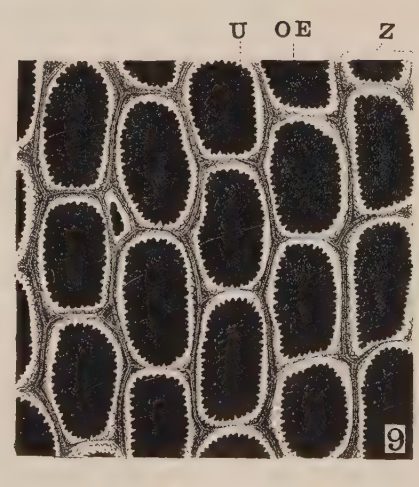
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BOOK NOTICES

Pedigrees and Checkerboards

This manual contains more than 100 pedigree charts of various animals and plants, in which the genotypes are to be filled in as far as possible from the phenotypes of the various related individuals. It also includes nearly a hundred problems involving checkerboards. The plants and animals represent diverse species both of the laboratory and of the farm and home. The types of inheritance involved are widely representative, including unit factors, epistasis, sex-linked and sex-influenced factors, multiple alleles, linkage, and chromosomal aberrations. In the plant material nothing is said of xenia, and the endosperm and aleurone are treated as though they contained factors in pairs. As long as all the genes used manifest xenia, this omission of course makes no practical difference in the results of the problems. The distinction between sex-influenced and sex-limited behavior is not drawn. The problems are well chosen, and should be of very practical value to the beginning genetics student.—*L. H. S.*

Pedigrees and Checkerboards, by E. F. Barrows. 223 pp., planographed. Ann Arbor, Edwards Bros. 1940. $1.50.

Physiology and Disease

The first edition of this very comprehensive treatise on medical physiology was reviewed in the Ohio Journal of Science for September, 1937. The fact that a second edition has appeared in only two years testifies both to the importance of the subject and to the success of the first edition. In addition to the many revisions in the text, a section has been added on special senses. This section comprises eight chapters, totaling nearly two hundred pages. The book admirably serves its purpose of bringing the principles of physiology into intimate contact with practical clinical problems.—*L. H. S.*

Physiological Basis of Medical Practice, by C. H. Best and N. B. Taylor. xvi+1872 pp. Baltimore, the Williams and Wilkins Co. 1939.

Exercises in Biology

Although the textbook, *Fundamentals of Biology*, may be used with profit in a non-laboratory course, Professor Haupt has prepared a manual of laboratory directions designed to accompany the material in his textbook. This manual, in the reviewer's opinion, does not attain the degree of excellence achieved in his textbook. The manual presents brief directions for 100 exercises. Since each is designed to be completed within a two-hour laboratory period, of necessity they must be sketchy. Where space is limited and large groups of students must be cared for this manual should prove satisfactory.—*Paul E. Schaefer.*

Laboratory Directions for General Biology, by Arthur W. Haupt. Third edition, 65 pp. New York, The McGraw-Hill Book Co. 1940. $1.00.

The Fundamentals of Life

The great expansion and compartmentalization of scientific knowledge is raising more problems and increasing the difficulty of solution for the teacher of the general courses in the physical and biological sciences. The development of the "principles" method of organization has seemed a step towards a solution, but what shall a text for such a course be and where can it be found? Since no one specific pattern can cover all "principles" courses certainly no one specific pattern can be laid down for such textbooks. Several books have appeared which seem to achieve some measure of success in aiding the student to orient himself with respect to the scope of biological science, its influence upon his life and its role in society.

Amongst those texts which seem usable for such a course, Haupt's Fundamentals of Biology certainly should have a place. In this third edition, although a botanist primarily, Professor Haupt has not slighted the animals but has achieved a rather comprehensive picture of biology without blatant sketchiness. There is a unity of organization which yet permits a degree of flexibility. The language is quite readable, and the general mechanics of the book very satisfactory. This book doubtless will not please everyone, for what book could, but many should find it exceedingly usable.—*Paul E. Schaefer.*

Fundamentals of Biology, by Arthur W. Haupt. Third edition, 443 pages. New York, The McGraw-Hill Book Co. 1940. $3.00.

Cosmic Rays and Mesotrons

This small paper-bound book is written from a research point of view and will be welcomed by graduate students who want a fundamental understanding of experimental cosmic-ray phenomena and their interpretations. The interpretations, however, do not extend to the questionable origin of cosmic rays.

A short chapter is devoted to experimental apparatus such as ionization chambers, Geiger-Müller counters, and Wilson cloud chambers. With these instruments data are obtained on the variation of cosmic-ray intensities with time and latitude, on the absorption of the rays in matter at high and low altitude, and on the penetration of cosmic rays to great depths. The most penetrating component of cosmic rays leads to the concept of mesotrons. The mesotron seems to be between 100 and 200 times as heavy as the electron. There is evidence that the average life of a mesotron is about one-millionth of a second.

In the chapter devoted to the application of the theory of electrons to cosmic rays, the subjects of ionization by collision, showers, and the production of secondaries in the upper atmosphere are effectively treated.

The ten tables and sixteen figures amply illustrate the text and help to make this book a very desirable one in the field of cosmic rays.—*M. L. Pool.*

Cosmic Rays and Mesotrons, by H. J. J. Braddick. 68 pp. Cambridge, at the University Press; in New York, the Macmillan Co. 1939. $1.50.

NOTICE

Copies of the *Ohio Journal of Science*, volume XLV, numbers 1 and 2, January and March, 1940, are needed for sending to the many new members of the Ohio Academy of Science. Those who have copies which they do not care to keep are asked to post them to the Botany and Zoology Library, Ohio State University, Columbus, Ohio.

THE FULL PROCEEDINGS OF THE FIFTIETH ANNIVERSARY MEETING, INCLUDING THE INVITATIONAL ADDRESSES, WILL BE PUBLISHED IN A LATER ISSUE.